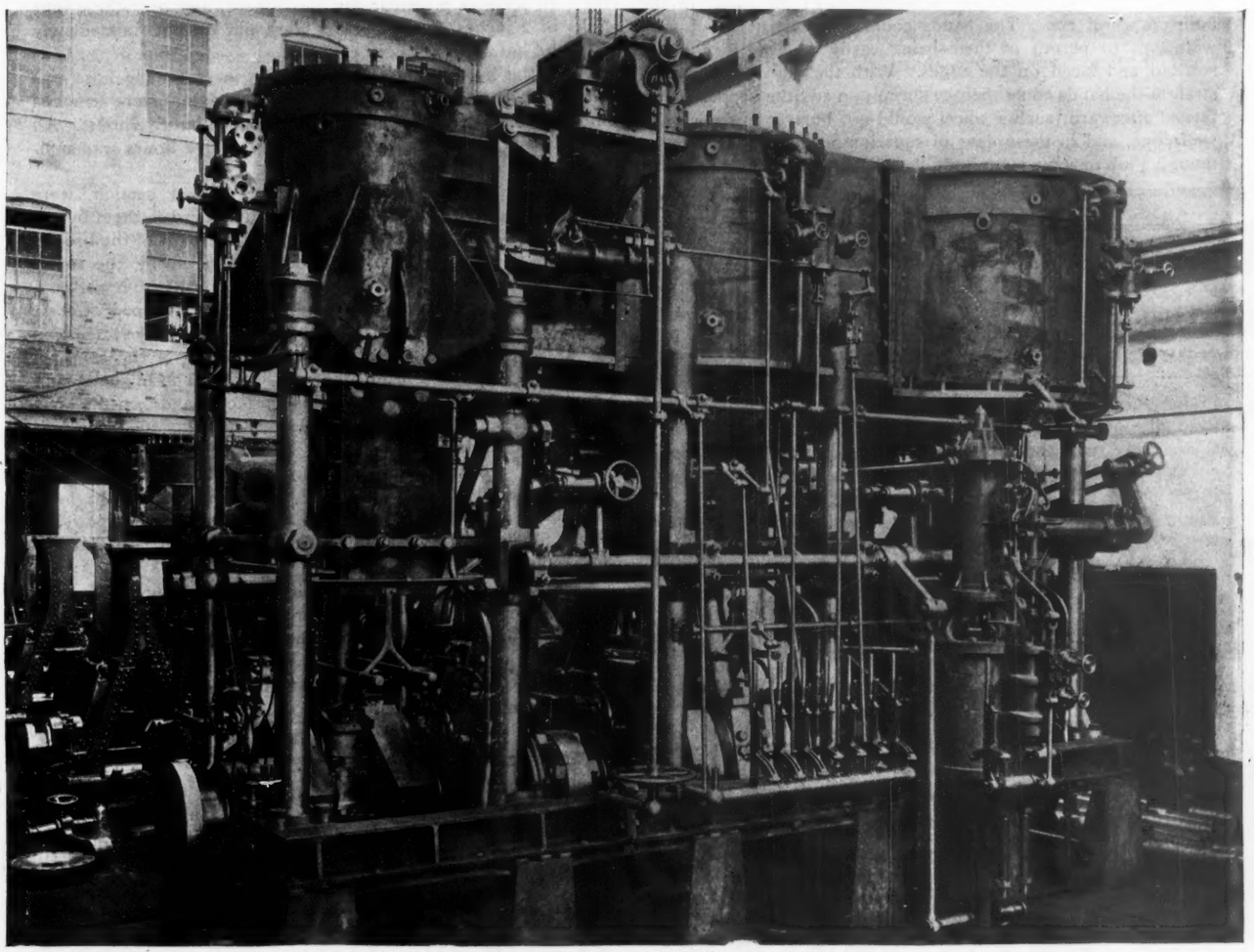
MACHINERY.

Vol. 4. April, 1898. No. 8.

THE ENGINES OF THE "MAINE."

Through the kindness of the Quintard Iron Works of New York, the builders of the propelling engines of the late battleship Maine, we are able to present an illustration of the starboard engine as it was erected in the shop before being placed on shipboard. The engine stood about 20 feet high, over all, and the photograph, which shows the machine in connection with its shop surroundings, gives an exceptionably good idea of its general proportions. The Maine was a twin-screw vessel and the two engines together developed about 9,000 horse-power at 120 revolutions.

Without attempting to give a complete description of the engines, a few of their more important specifications will be of interest.



ONE OF THE ENGINES AS IT APPEARED ON THE ERECTING FLOOR OF THE SHOP.

They were triple expansion engines with cylinders 35½×57×88×36-inches stroke.

The frames were of steel throughout. The bed-plates were of ribbed section, the H. P. and L. P. cylinders were supported by hollow, forged columns and the I. P. cylinder by a single inverted Y at the front of each engine.

The cylinders were jacketed. Stephenson link motion was used for the valves. The cranks were at 120 degrees and followed in order.

The piston and connecting-rods were of forged steel, the former 6¼ inches in diameter and the latter 72 inches long, thus giving a ratio of crank to connecting-rod of 1 to 4. The lower ends of the piston rods were enlarged to form the cross-heads, which were of the slipper pattern, running on single guides as is common in marine practice.

The crank shafts were hollow, 13 inches outside diameter and 4 inches inside. These shafts were made in three sections, bolted together with flanged couplings and the sections were intended to be interchangeable.

As at the ordinary cruising speed only about 1,500 to 2,000 horse-power was necessary, arrangements were made for disconnecting the low-pressure cylinders and running compound with the intermediate cylinders serving as low pressure cylinders and exhausting into the condensers. To this end the low-pressure cylinders were placed forward and could be disconnected by uncoupling the sections of the shafts belonging to them. Much better economy was thus realized at low power than would have been possible by running triple expansion with all the cylinders under these conditions. On the trial trip at full speed 2.18 pounds of coal were used per horse-power per hour, and at cruising speed, when running compound, only 2.22 pounds were used. Steam pressure ordinarily carried 135 pounds.

Referring to the illustration, the main features of the design will be evident. The view shows the rear of the engine. The throttle valve is located between the H. P. and I. P. cylinders and

has two gridiron valves, one of which is operated by means of the hand-wheel seen at the lower end of the vertical shaft and the other valve is designed for quick and positive action and is operated by means of the steam cylinder placed below the throttle valve. The hand-operated valve is chiefly for purposes of regulation.

The engine is reversed through the horizontal reversing shaft seen in the foreground. This is operated either by steam or hydraulic power. The hydraulic and steam cylinders are shown at the further end of the reversing shaft in the foreground at the right of the photograph. The hydraulic cylinder also serves to hold the links in position.

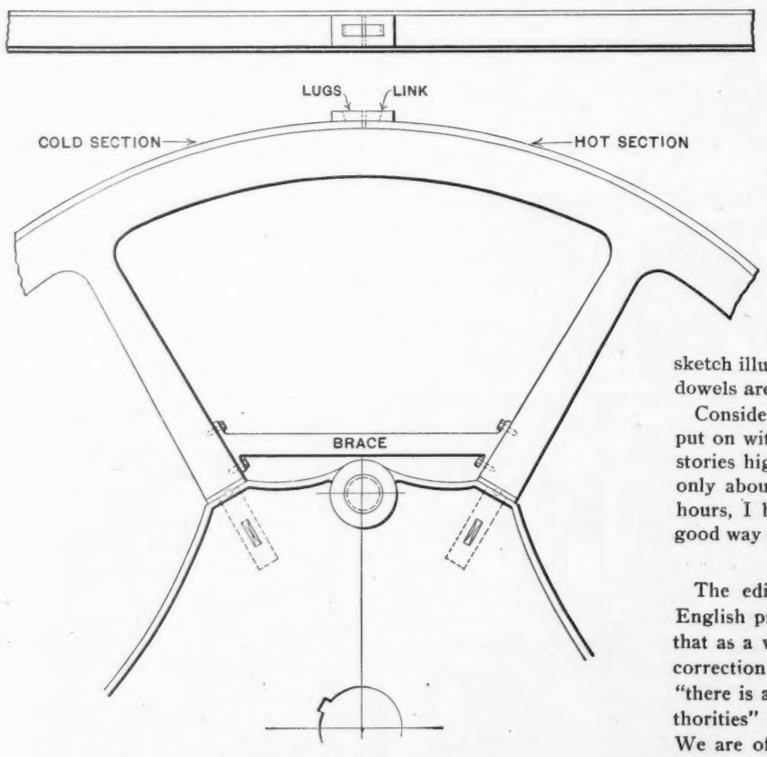
Starting valves are employed on each cylinder for starting the engine and warming up the cylinders.

* * *

REPAIRING A FLY-WHEEL.

C. E. MINK.

In view of the frequent bursting of flywheels, the thought has frequently come to me, Why not guard against this by shrinking wrought-iron bands on their faces? I may be wrong, but I am of the opinion that if the work was properly done such wheels would be stronger than when built up, and in these days of large boring mills, could be done as cheaply, particularly when we take into consideration the cost of the construction of the joints of the built-up wheel rim. The bands could be constructed of such widths as to permit of their being easily welded, then bored straight and faced on the edges. With the wheel face turned straight the bands could then be shrunk on and the proper crown turned afterward; such a wheel would not burst if the work was well done, and in these days of superior mechanical appliances, though a job of some magnitude, it is not a very difficult one.



In 1880 or '81 I had charge of a couple of blast furnace engines at Geddes, N. Y. The flywheels were 18 feet in diameter and of the built-up type. The hub was one casting, in which the crank pin was secured, and the sockets for the tenons of the arms were bored and had faced shoulders against which the shoulders of the arms fitted. The arms were cast in one piece with a segment of the rim, the arm being in the center of the segment, and the tenon on the end of the arm turned to fit the socket of the hub and secured by a key. Each end of the segment was secured to its fellow by a dowel pin and keys. The rim was rectangular in form, 7 inches wide by 9 inches deep. The tenons of the wheels of one of the engines (there being a wheel on each side of each engine), were too light, and one morning I discovered that two of them were broken off close in the neck next the shoulder on the hub, and on examining the wheel on the other side of the engine discovered three broken tenons there. We had just got nicely into blast, iron was high, and a blast furnace engine cannot be stopped long without great loss; so I stood by the engine until I had planned a way out of the trouble, then went home and made a drawing for the bands that were to cure the difficulty, letting the broken wheels run, and trusting to luck that arms enough would remain sound to hold until the bands were on, the engineer being cautioned to keep close watch and not stand near the wheels longer than could be helped. The forgings for the bands were made by a good smith named Isaac Tebow, employed by Cobb, Herrick & Co., of Syracuse. The bands were 1¼ inches thick by 6 inches wide, and made in four sections, three sections being put on cold and clamped tightly to their place by many clamps. The joints of these three sections were secured by lap plates of the same width and thickness as the bands, and long enough to receive eight turned 1-inch tap bolts on each side of the joints, which were all screwed tight before putting on the last segment. This segment was heated in a wood fire built around it outdoors, and put on red-hot, allowance having been made for shrinking. On each end of the hot section and in the center of its face was forged a lug 2 inches high and 2 inches thick, long enough to have the necessary strength, the end back of the joint being dovetailed, as shown in the engraving. On each of the corresponding ends of the cold sections a similar lug was forged, and over these lugs links of 2 inches square section were put on hot, immediately after the hot section was in position.

After the hot section and links were in place, the hose was turned on, and when the band was cool the clamps were removed and the engine started, it having been stopped but five hours. All being ready the next day, another stop of five hours was sufficient to put on the other band.

Cast iron braces, rectangular in section, were fitted between each arm and secured to them by tap bolts through flanges cast on the ends of the braces. Each broken arm was thus braced by the sound ones, and to further prevent the arms from working, the broken arms were drilled and tapped at their junction with the hub, and a steel dowell screwed in tight. There was no movement of the arms on the hubs after this was done. These bands and braces held the wheels perfectly and kept them in service through the blast, which lasted about four years. Before going in blast again new wheels were put on, but the old wheels were in perfect order when taken off, and would no doubt have served through another blast. The accompanying sketch illustrates the link in position, one of the braces and the dowels are also shown.

Considering the fact that an entire band could not have been put on without tearing down the engine house, which was three stories high, and that the engine was stopped for all the fitting only about thirty-five hours, the longest single stop being five hours, I believe that this method of making the repairs was a good way out of a serious difficulty.

* * *

The editor of "The Mechanical Engineer," in referring to English practice, presumably, in testing indicator springs, states that as a wide range of pressure exists in a single diagram, any correction for temperature can be only approximate, and that "there is a difference of opinion amongst those who pose as authorities" as to whether springs should be tested hot or cold. We are of the opinion that the wide range of pressures in the diagram can have very little effect upon the action of the spring, since the spring is always exposed to atmospheric pressure, and therefore the steam coming in contact with it must always be nearly or quite at 212 degrees, whatever the pressure shown by the diagram. As far as testing hot or cold water is concerned, Mr. Charles T. Porter found, as long ago as the time when he was making the Richards indicator, that a spring tested cold would register one pound in forty lower than when tested hot. It is therefore plainly evident that if a spring is tested cold it will not be correct under steam pressure unless a correction is allowed. We think there is no question but that a spring should be tested in the indicator itself and under steam, which are the conditions met with in actual use.

A NEW SHOP SYSTEM.*—2.

GEO. D. CHAPMAN.

3rd.—THE PATTERNS.

Orders for the pattern department, made out as previously described, are taken as needed from the "Pattern Requisition" till in the Engineering Office Cabinet, and the original given to the pattern maker, the duplicate being filed in the "Pattern Makers'" till.

When the pattern is done the order is returned to the office, the pattern marked on the "Casting List" (this list will be later described), and the duplicate destroyed, the original being checked and filed in an envelope marked "Patterns Done" in the proper "Machine Till" in the cabinet.

By this system at any time the past, present and future of a machine can be quickly and readily told right in the engineering office.

By referring to the "machine till" the drawings and patterns made or changed can be ascertained, as the original orders are there; this is the past. The "Draftsmen" and "Pattern Makers'" tills show the drawings and patterns in progress and the men working on same, as the duplicate orders are there; this is the present. By looking in the "Machine," "Drawing Requisition" and "Pattern Requisition" tills the new work and changes to be made can be seen; this is the future.

4th.—THE STOCK.

Lists of all the pieces for each "part" of each machine are made on tracings under the drawing head of "Lists," and from drawing orders given from the Engineering Office, as previously described. Cross lists of the piece numbers are also made to keep track of the numbers used and where they are listed.

4-27-'97 FITCHBURG MACHINE WORKS. **L-330**

"CHAPMAN DUPLEX" FEED.

13 L-12 GEM ..... CASTINGS.

NAME.	Pat. No.	Stock.	No. Pcs.	On hand.	Date.	Start.
Feed cone	13 L 63	C. I.	1			
Head hanger	13 L 63	"	1			
Tail hanger	13 L 64	"	1			
Clutch gear	13 L 65	"	1			
Intermediate gear	13 L 66	"	1			
Ecc. stud	13 L 67	"	1			
Head hanger cap	13 L 379 C	Comp.	1			

Sheet 534

4-30-'97 FITCHBURG MACHINE WORKS. **L-331**

"CHAPMAN DUPLEX" FEED.

13 L-12 GEM ..... STEEL.

NAME.	Dia.	Length	Pc. No.	Stock	No. Pcs.	On hand.	Date.	Start.
Screw			13 L 0057	B. S.	1			
Intermediate driving screw	1⅛ in.	5⅜ in.	13 L 0058	"	1			
Feed cone stud	1 in.	6⅜ in.	13 L 0059	"	1			
Feed cone stud small washer	Turret.		13 L 0060	"	1			
Feed cone stud large washer	Turret.		13 L 0061	"	1			
Feed cone stud collar	1 1/16 in.	1/16 in.	13 L 0062	"	1			
Intermediate gear stud	1 in.	4 1/16 inch	13 L 0063	"	1			
Intermediate gear stud washer	Turret.		13 L 0064	"	2			
Intermediate pinion	2 in.	1⅛ in.	13 L 0065	"	1			
Feed cone pinion	2 in.	¾ in.	13 L 0066	"	1			
Screw collar	1⅜ in.	1⅛ in.	13 L 0067	"	1			
Screw step screw	Turret.		13 L 0068	"	1			
Fixed clutch	Turret.		13 L 0069	"	1			
Sliding clutch	Turret.		13 L 0070	"	1			
Clutch knob	Turret.		13 L 0071	"	1			
Head hanger dowell	⅜ in.	1¼ in.	13 L 0072	C.D.	2			
Tail hanger dowell	1/16 in.	1 in.	13 L 0073	"	2			

Sheet 502

Such "Lists" of the gem lathe are here shown. "L—330" is for the castings, and "L—331" for the steel and cut-off. These are of "part 12" (hangers, rod and screw) only, others are made for other "parts" as headstock, "part 1," carriage "part 4," etc. On these "Lists" the "No. Pcs." signifies the number of pieces for one machine.

When a new lot of machines are to be ordered a new set of "blue prints" is taken of all the lists referring to said machine; these prints are light colored so that black ink may be used.

In the column "On Hand" are marked any pieces that may for any reason be in stock. If another lot has been previously built the "On hand" may be checked off from those lists, as the "Stock Ordered" lists are kept on file in the Engineering Office until the next lot have been marked up.

As the patterns are completed and the pattern orders returned the number of pieces to be ordered is set down in the "Start" column.

When these pieces are ordered the date is set down in the "Date" column, and date and number in lot of "parts" of machine ordered are entered on the "Record" list. So that "parts" ordered can be readily ascertained. (This list L—317 and its purposes will be later explained.)

The foundry foreman checkmarks the pieces on these lists as he orders them, returning the lists again to the Engineering Office. If these are not completed the lists are put on the file board of "Stock in Progress," if completed they are put upon the "Stock Ordered" file.

The same applies to the steel and other lists, only they pass through the order clerk's hands, and not the foundry foreman's.

5th.—THE RECORD.

Referring to "L—317," page 238, it will be seen that all the drawings and lists for said machine are set down under the parts to which they refer.

A "blue print," light colored, so that black ink may be used, of this "Record" is taken for the Engineering Office when a new lot of machines are to be ordered, and on this print is put under the list number in the blank space, the number of the lot, as 5, fifth lot of this machine ordered. The "Record" is always up to date by reason of the "Rules for Indexing" previously described.

Upon this "Record" in the blank in the upper left hand corner is entered the date the first "part" or "parts" were started, and in the upper right hand corner the date completed.

All "parts" on hand are entered in the "On Hand" column. These may be taken from former "Record" if a previous lot of this machine has been built. In the "Date" and "Start" columns are noted the dates and number of "parts" started as per lists "L—330" and "L—331," etc., described under "The Stock." In "Date" and "Comp." columns are entered the dates and number of "parts" completed as reported from the shop.

MACHINES COMPLETED.

Each machine as it is completed is stamped with a tool number and arrow, the arrow being put on simply to distinguish this from other numbers. These tool numbers run consecutively, regardless of the kind of machine. The test on all machines is finely and accurately made, and a "test sheet" with the results is given to the Engineering Office by the inspector who has previously stamped the tool with his insignia.

The recording of the tool then takes place, the data being taken from the "test sheet," and the rules below being followed.

RULES FOR RECORDING COMPLETED MACHINES.

1. Enter upon "Record."

In the case in hand enter on "L—317" as follows; put the tool number in the space at the top of the "Record" marked for it, put a dot in the "Used" column for every "part" used on this particular tool. If any special remarks be necessary they are entered under "Changes," with the tool number preceding the remark. Put the tool number in the "Used" column, opposite the bed used. This will show the length of bed for the tool without further remarks. Also put the date in the "Date" column opposite the bed used, to show the date the tool was completed.

2. Make out "Tool" index card.

TOOL INDEX CARD.

2143		14x6 L GEM.
9-28-'97	L-317 2	Comp. car. Power X feed.
		"Chapman Duplex" feed. 1 3/32 inch hole.
9-29-'97	.....	In shop.
10-5-'97	.....	JONES MFG. CO., Philadelphia, Pa.

* The first half of this article appeared in the March issue.

3-22-'97

FITCHBURG MACHINE WORKS.

L-317

TOOL NUMBERS.

13 L GEM

STARTED .....

RECORD COMPLETED .....

DRAWINGS.

1	2	4					8		11	12	14	15	18	19	20		1	Ass.
1664	1674	1689	....	....	....	....	1681	....	1688	1685	1697	1695	1666	1693	1692	....	....	1729
1665	1675	1690	....	....	....	....	1682	....	....	1686	1718	....	....	....	....	....	....	....
1666	1676	1691	....	....	....	....	1683	....	....	1688	....	....	....	....	....	....	....	....
1667	1677	1694	....	....	....	....	1684	....	....	1727	....	....	....	....	....	....	....	....
1668	....	....	....	....	....	....	1728	....	....	....	....	....	....	...	....	....	....	....
1669	....	....	....	....	....	...	....	....	....	....	....	....	....	....	....	....	....	....
1670	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
1671	....	....	....	....	....	....	.. .	...	....	....	....	....	....	....	....	....	....	....
1672	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	...	....
1678	L-325	L-332	....	....	....	....	L-327	....	....	L-331	L-323	L-333	....	L-323	L-323	L-322	L-319	....
L-318	L-324	L-324	....	....	....	....	L-328	....	....	L-330	L-335	L-336	L-326	L-335	L-335	L-320	....	....

CHANGES.

Class.	Part.	On hand.	Date.	Start.	Date.	Comp.	Used.	On hand.	Date.	Start.	Date.	Comp.	Used.	On hand.
1	Headstock	....	....	....	....	....	....	....	....	....	....	....	....	....
2	Tailstock	....	....	....	....	....	....	....	....	....	....	....	....	....
4	Carriage Comp	....	....	....	....	....	....	....	....	....	....	....	....	....
.	.....	....	....	....	....	....	....	....	....	....	....	....	....	....
8	Apron	....	....	....	....	....	....	....	....	....	....	....	....	....
	.....	....	....	....	....	....	....	....	....	....	....	....	....	....
11	Screw (spline)	....	....	....	....	....	....	....	....	....	....	....	....	....
12	Hanger, rod and screw	....	....	....	....	....	....	....	....	....	....	....	....	....
14	Screw gears—studs	....	....	....	....	....	....	....	....	....	....	....	....	....
15	Steady rest	....	....	....	....	....	....	....	....	....	....	....	....	....
18	Countershaft	....	....	....	....	....	....	....	....	....	....	....	....	....
19	Legs	....	....	....	....	....	....	....	....	....	....	....	....	....
..	.....	...	....	....	....	....	....	....	....	....	....	....	....	....
20	Bed	....	....	....	....	....	....	....	....	....	....	....	....	....
..	.....	....	....	....	....	....	....	....	....	....	....	....	....	....
..	.....	....	....	....	....	...	....	....	....	...	....	....	....	....

Sheet 323

TOOL INDEX CARD.

Referring to the card on page 237, "2143" is the tool number "14 x 6 L Gem" means 14-inch swing by 6 feet bed Gem engine lathe. "9—28—'97" is the date completed. "L—317" means that this tool was built for drawings shown on "Record" L—317, sub. 2 (the significance of this "sub 2" is explained under head of "Record"), and according to remarks there set down. The short description explains itself.

3. If for our stock, put card behind proper "guide card" in stock division. These cards are kept in the Engineering Office cabinet, and the till has "guide cards" arranged and labeled according to the "class" of tool.

4. If for our shop, mark date turned over to shop and "In Shop" and place behind proper "guide card" in shop division. This is entered as shown on "Tool index card," and this till has "guide cards" arranged and marked, according to shop department and "class" of tool.

5. If for shipment, enter date shipped and party shipped to on card, and put behind proper "guide card" in sold division.

This is marked as shown in cut of "Tool index card," the till for this is provided with "guide cards" arranged and marked numerically, and the card is placed according to "Tool Number."

When the above records have been made, the "test sheet" is turned over to the Office Cost Department, that they may make out their accounts, etc.

By this system there is ready at hand in the Engineering Office proper information to at once tell what pieces of stock are in progress by referring to "Stock in Progress" file, described under "Stock;" what "parts" started or completed by referring to the "Record" on file; what completed tools in stock, by referring to cards in stock division till; and what tools in shop in use, by referring to shop division till; these cards also give the information necessary to find just how these tools were built and what drawings were used.

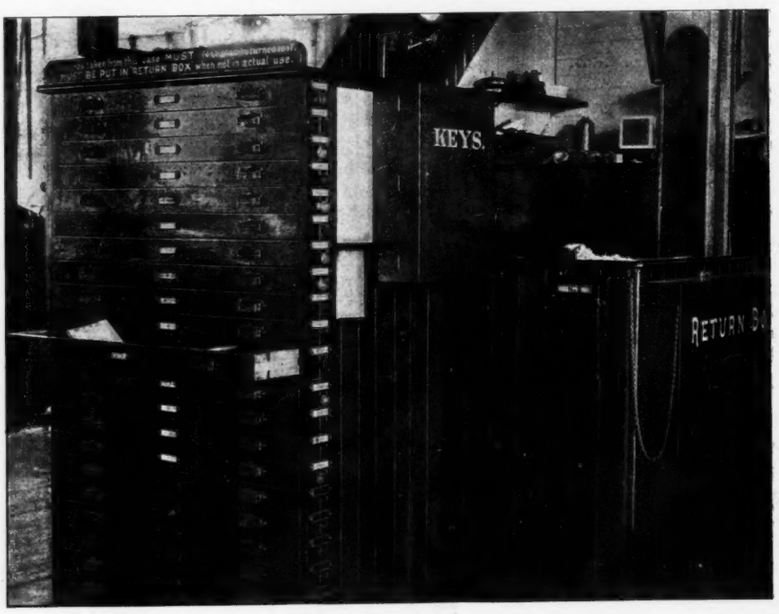
If repairs are wanted on any tool, by having the "tool number" given the card can be quickly found which gives all the information in regard to drawings, etc.

6th.—THE SHOP WORKING DRAWINGS.

The work in the shop is generally done from "blue prints" of drawings, although for special jobs "sketches" are used, as described under the head of "Drawings."

Only such prints are kept in the shop as are needed for machines at the time in progress, the surplus being kept in drawers in "Drawing Room Case," previously described.

The drawings in the shop for each machine in progress are kept in the "Shop Drawing Case," which has a drawer labeled for each machine, and opposite each drawer is a hook and a corresponding



SHOP DRAWING CASE.

label; this hook is to receive the check of each man who takes a drawing or drawings out of said drawer. "Blue print" labels are here used also, to save expense. These labels are changed as the drawer becomes empty, by reason of machines being completed, and a new lot of a different class being started.

The drawings are put in the shop drawing case by the drawing room clerk, who enters each drawing number upon a file in the drawing room, for checking and ready reference.

The "blue prints" are taken from the case by the men as they are needed, each man putting his check upon the hook opposite

the drawer, as previously described, and when he has returned all "blue prints" for that machine he removes his check .

In order to keep the proper contents in each drawer and to prevent loss of drawings, the following "notice" is put above the case and followed: "Drawings taken from this case must not be returned to it, but must be put in 'return box' when not in actual use."

This "return box" is near the shop drawing case, as shown in the cut. The drawing room clerk each day sorts the contents of this box into the proper drawers in the case.

When any particular lot of machines are completed the prints referring to said machine are all brought into the drawing room, and, if not too worn, are put away in the drawers for surplus in the drawing room case, previously described. At the same time they are checked from the lists, to see that all the drawings put into the shop are returned.

So far, in the two years this system has been used, not a single drawing has been lost. This cannot be said of the "old way."

The checks hung on the hooks on the shop drawing case enable a workman to easily find a drawing not then in the drawer, for he has only to go to such few men as have their checks on said hook, and is not obliged to waste half an hour asking every man in the shop "Have you such or such a drawing?"

7th.—THE SHOP COSTS.

The cost is kept on each and every piece of a machine. This is done by aid of the system of piece numbers, described in the previous article, the symbols designating the piece and the machine to which it belongs being written within a 5/8-inch circle placed beside the piece, as shown on the drawing. On each drawing is the following "notice": "On day time slip you must charge time to marks in circle. Also state number of pieces in lot you are working on."

This "notice" is made upon a separate tracing and used on the drawing when the print is to be taken, thereby saving expense of printing the "notice" on each drawing, and adding to the prominence of said "notice," as it appears lighter than the rest of the print.

There is never any doubt in the mind of the workman what he is to put upon his time slip, for he is only to copy marks in the circle accompanying each piece, and what is more it has been found that all the men make satisfactory copyists in this particular.

DAILY TIME SHEET, MADE OUT BY THE WORKMAN.

DAILY TIME SHEET. **45**

FITCHBURG, 9-13-1897.

NUMBER OF JOB.	Description of Work.	Hours.
13 L / 64	50 pcs. Drilling and tapping.	6
C D / 377 C	12 pcs. Turning.	4
		10

The "Daily Time Sheet" is used, made in blocks 3 x 5 inches, each block having a pencil attached, and each man having a number, as shown in the upper right hand corner.

Referring to the "Daily Time Sheet," here shown, man No. "45" worked on Sept. 13, 1897, six hours on drilling and tapping 50 pieces $\frac{13\,L}{64}$ (the meaning of $\frac{13\,L}{64}$ has been previously explained); and he worked four hours on turning twelve pieces $\frac{CD}{377C}$, making ten hours total.

These sheets are put by each man, at the end of his day's work, into a locked box near the department foreman's desk, and the foreman each day inspects these "sheets" and checks their correctness, after which he gives them to the time clerk.

The time clerk, after sorting out these sheets, charges the time to the proper pieces on the "cost sheet," of which a sample is here shown.

These "cost sheets" are kept on file boards, one for each class of machine. The sheets are arranged for quick reference numerically, according to the kind of piece, there being a sheet for each piece. The numbers, as previously described, run from "1" up, from "001" up, and from "01" up.

The amount of stock per lot is reported from the stock room to the cost department, and is entered upon the "Cost Sheet," as shown.

To obtain the bulk cost of a complete machine, a list is arranged of all the pieces for said machine, with columns for name of piece, piece number, number pieces per machine, labor, stock and total.

In the "labor" column is put the labor per piece, and in the "stock" column the cost of stock per piece, as ascertained from the "Cost Sheet," just described. The "total" column is for stock and labor total. The "total" column is footed up, giving the bulk of stock and labor per machine. To this, to obtain the true cost, must be added the "expense load." These summary cost sheets are kept in a convenient file in the office for quick reference.

COST SHEET.

CLASS 13-L. GEM LATHE 14 IN. No. 64
Started 9-13-'97 Completed 9-15-'97
STOCK. Kind, C. I. Wt., 5 Cost, .125 LABOR. .168 COST. Each Pc., .293

Date.	Lot of	No. man.	Labor. Hrs.	Price.	Total.
9-13	50	45	6	20	1.20
"	"	60	10	"	2.
"	"	12	8	15	1.20
9-14	"	45	10	20	2.
"	"	60	2	"	.40
9 15	"	45	8	"	1.60
			44		8.40

Total..... 8.40

Date.	Lot of	No. man.	Stock. Kind.	Wt.	Price.	Total.
9-13	50	45	C. I.	250	2½	6.25
Total						6.25

Total Labor	8.40
Stock	6.25
Total	14.65
Lot of 50.	
Cost each Pc.	.293
Hours each Pc.	.8⅝
Av. wage per hour	.191

In this manner the cost of each piece is kept so that the investigator can readily find out where the excessive money has gone, and locate the cause of the large cost of the completed machine. By the old method of bulk cost only, it was impossible to locate the trouble, and therefore impossible to correct it.

This "New Shop System" deals with facts throughout, everything being done by written order, and these orders are so kept that at any time the state of work in the different departments of drawing, pattern and shop can be readily and accurately ascertained; that is, the information is in the office to quickly tell the drawings and patterns made, making and to be made; the stock ordered, in progress and to be ordered; the "parts" and whole tools completed, in process of construction and to be built; the drawing and stock used on any machine built or being built; and the cost of stock and labor for each piece of each machine.

* * *

A WORD ABOUT TEST BARS.

To the Editor of MACHINERY:

In the article of Mr. Field on test bars and their relation to the strength of castings, appearing in your February number, a statement is attributed to me which I cannot recollect having made. Only two articles on this subject have appeared from my pen, and in neither of them do I find myself advocating the "impossible and absurd" proposition of a universal test bar.

On the contrary, what is wanted is a universal system of test bars which will cover all the cases met with in the various products of cast iron.

Mr. Field's whole article is a very able plea for such a system. The series of apparent contradictions in the behavior of cast iron test samples he brings out are perfectly familiar to foundrymen, and it is gradually bringing them to the conclusion that more and deeper study is necessary before a judgment of any kind can be formed. Thus, if Mr. Field had grasped the situation properly, based as it must be upon the recognition of cast iron as a mineral in its constitution, he would not have advocated the tensile test so warmly, without surrounding it with a very considerable number of safeguards, and giving very definite specifications as to the shape and manner of testing the samples supposed to represent the castings.

The well-known fact that test bars can be manipulated to show almost anything desired, only emphasizes the necessity of definite specifications to cover definite classes of work; which is the proposition I am advocating, and not what Mr. Field attributes to me.

R. MOLDENKE.

Pittsburg, Pa.

FROM VARIOUS SHOPS.

DRILL PRESS FIXTURES—A NOVEL KEY-SEATER—DRILLING CURVED HOLES—A MILLING JIG—SOME HANDY PARALLELS.

At the Machinery Construction Co., Rochester, N. Y., I was shown through the works by their genial superintendent, Mr. C. A. Macy. One of their specialties is a machine for making wooden boxes with the interlocking corners, and they seem to be well equipped for turning out a good article; they also do contract work in the way of building special machinery, and Mr. Macy seems to have a peculiar faculty of getting around the snags met with in that line, and believes in a liberal exchange of mechanical ideas, so I will devote the limited space that I have to some of the things that may be of interest to young mechanics who are somewhat neglected by most correspondents to technical papers who apparently think because a device is old to them it must be to everyone else.

One of the rigs that Mr. Macy credits the saving of a considerable time to is the fixture for chucking small bevel gears shown in Fig. 1. As will be seen, it is a very simple affair to be used on an upright drill. I don't know as my sketches are exactly correct, but will describe the fixture as well as I can from memory.

The casting *A* is bored out to receive a series of rings, *B*, for the different sizes of gears, and some of these rings have several shoulders on them to fit as many different sizes of gear blanks—one with two shoulders is shown in the cut, and its other side could be made similar.

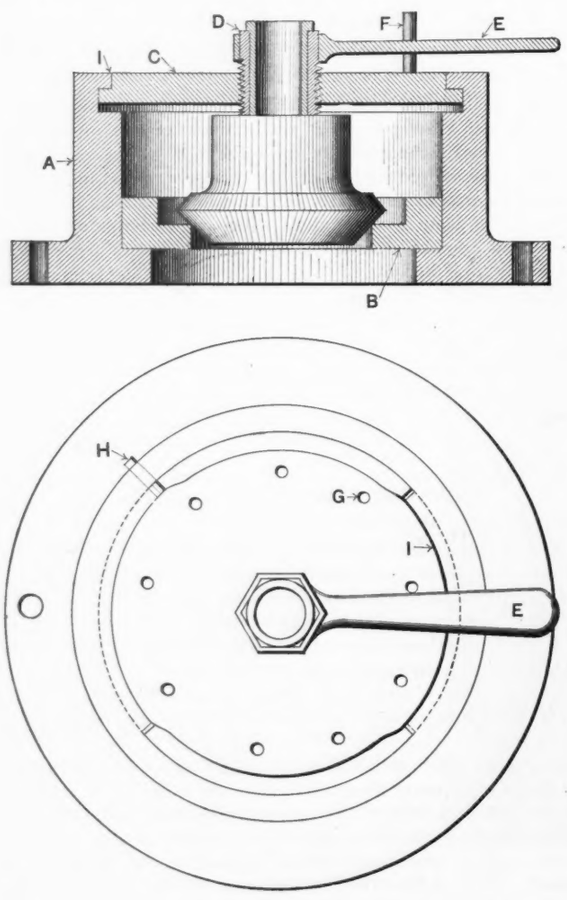


FIG. 1.

Fitted to the top of *A* is a head *C* through which a hardened steel bushing *D* is screwed by a wrench *E* fitting its upper end, and drill or reamer bushings for different sizes fit inside of this screw bushing. In the top of the head *C* is a row of holes forming a circle to receive the pin *F*. By referring to the sketch it will be seen that the head can be lifted out when it has been turned quarter way around, and the pin is to facilitate this part of the work as follows: When a gear blank has been put in, the head inserted and turned to place, the bushing is screwed down against the blank and the pin driven into one of the holes, *G*, probably 45 degrees or more behind the wrench. Then when the gear blank has been drilled and reamed, a push on the wrench removes the pressure on the work and the head both by the time it strikes the pin, and by turning the wrench still further in the same direction swings the head around to the position for lifting out. When once adjusted the wrench and pin are not removed until a different size of work makes it necessary, and all that is necessary in setting a blank is to slip it down into the fixture and insert the head piece, hold the pin and wrench together until the head swings into place and brings up against the stop *H*. Continuing the motion of the wrench in the same direction screws the bushing down against the gear blank, locking all firmly.

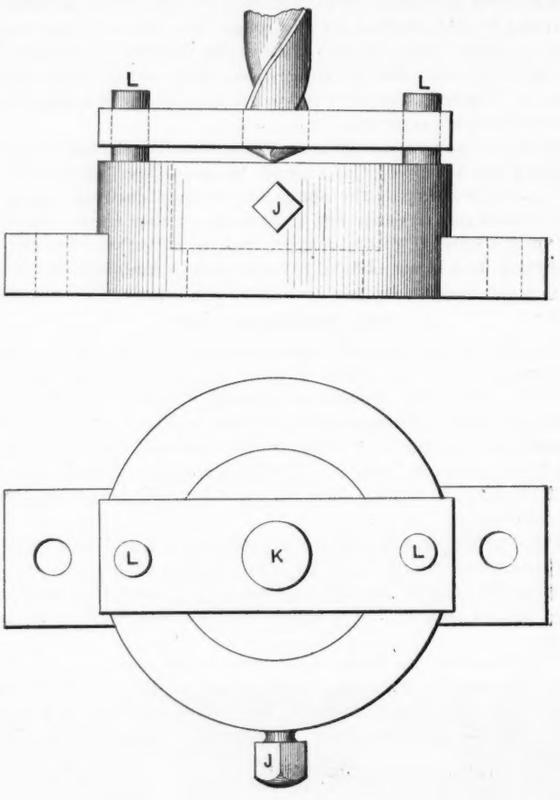


FIG. 2.

From the foregoing it will be seen that a blank can be set for drilling about as readily as a latch could be swung into place and a set screw tightened. The joint *I*, between the head and the body of the fixture, is made a close fit so as to locate the bushing center with the work.

Mr. Macy believes that much time can be saved by using an upright drill to chuck other work besides bevel-gear blanks, and Fig. 2 was seen in use. It is nothing but a casting faced off on the bottom and bored out to receive the discs to be chucked, which are held by the set screw *J* pointing slightly downward to prevent the work lifting off from its seat in the jig when the screw is tightened. The position of the hole *K* for the drill is determined by the pins *L L*, from which it can be easily lifted to change the work.

These rigs certainly are effectual in preventing the loss of time that some men waste trying to true up a piece to a nicety when a "wabble" of 1-16 of an inch would be of no consequence, which is at least one point in their favor. It seems, also, that they could be operated more rapidly than an ordinary lathe and chuck, which takes at least some time to start and stop on each piece, while the drill press is left running.

A Novel Key Seater.

Satisfactory results are claimed for Fig. 3, in doing a job of key seating so much out of the ordinary proportions that none of the regular machines would do it. The holes to be key seated were 2 inches long and only ⅝ inch diameter, with a key way ¼ inch wide and 3-16 inch deep. *M* is a plain piece of stock with the ⅝-inch pin *N* passing through it, on the upper end of which the pieces to be key seated are placed. In the side of *N* is a slot ¼ inch wide, to receive the cutter *O* and the wedge *P*; the

bottom of the slot being tapered to correspond to the taper of the wedge. Withdrawing the wedge makes room for the cutter to be pushed back to allow the blank to be key seated to be slipped on over *N* and fastened, when the wedge is reinserted and pushed down, forcing the cutter to its work with its teeth parallel to the side of the hole, while the lever *R* is worked pump-handle fashion.

Mr. Macy informs me that the friction on the wedge was just about enough to make it work nicely for a feed.

It would have been a question in my mind whether the chips would not wedge in and crumble the points of the teeth off on the up stroke, especially on wrought iron or steel, if the rig had not shown that it had seen use without any such results.

A Milling Fixture.

Fig. 4 is a milling fixture that was found at the Machine Construction Co.'s, also. There were about fifty rectangular pieces, *B*, about half an inch thick with a cam slot in each similar to *C*, that had to be milled, and all of them milled exactly alike, with prospects of another large order.

There are but three pieces to the whole rig besides the screw and hinge rivet, and cost but a few dollars. The shank of the

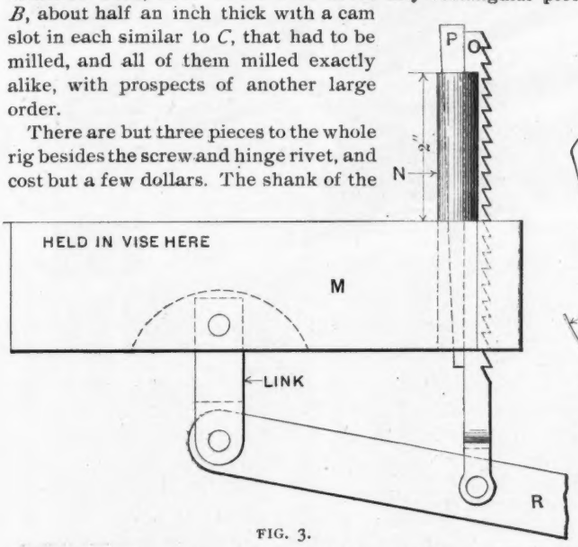
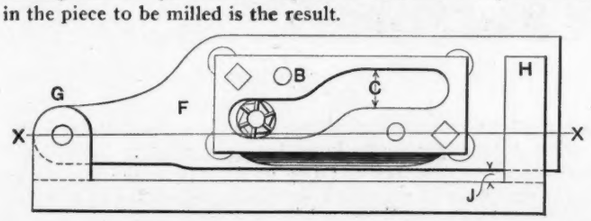
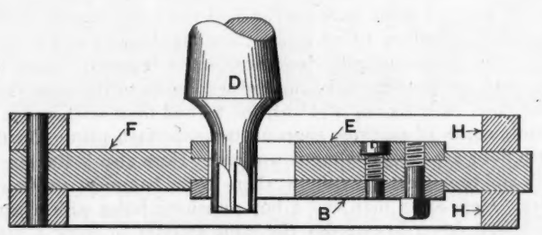


FIG. 3.

mill *D* fitted a duplicate slot in the hardened guide *E*, and projected through the piece to be milled, *B*, fitting into a recess on the front side of *F* to give it the proper location. It will be readily seen that with one end of *F* hinged at *G*, the other end will rise and fall between *H H*, guided by the slot in *E*, while the fixture on the milling machine platen is fed by the cutter, and a duplicate slot in the piece to be milled is the result.





SECTION THROUGH X-X

FIG. 4.

One good point about this rig seems to be that the work and mill are held in such a manner that the mill cannot crowd into the work and leave a jog in the slot.

I observe, when too late, that I have not shown the proper distance between the two parts at *J;* in fact, I have made no attempt to draw to scale, and if the construction is understood that is all that is necessary.

Drilling a Curved Hole.

One seldom has occasion to bore a hole on the arc of a circle like the hole through a piece of bicycle tire, but that is what I saw them doing at the Eppler Welt Machine Co., in Boston.

The radius of the arc was an inch and a quarter, and the holes, about 1-16 of an inch in diameter, were being drilled through pieces of cast steel ¼ of an inch thick.

The pieces drilled were shaped about like *A*, Fig. 5, and the holes had to be very accurate, everything about the machine being made on the duplicate parts plan, and this particular piece was the guide for the needle used to sew the welt on to the bottom of a shoe without going through, and which worked in a circle.

It was an interesting machine, built to run at 350 stitches per minute and involving a number of interesting kinks in its construction, but I will content myself with describing how they did this one job only, which was very simple:

The piece *A* was pivoted by slipping it down over the end of a perpendicular shaft *B*, fitting the hole *C* and bringing up against a shoulder at the proper height, then pressed against the drill by

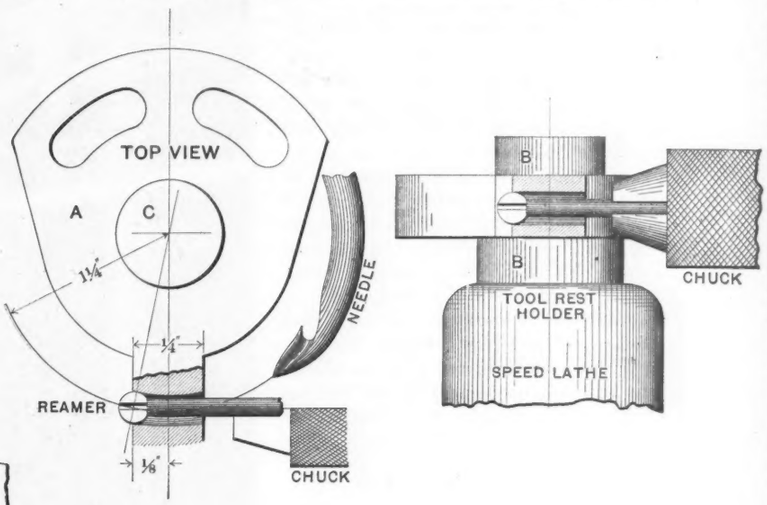


FIG. 5.

hand, the pivot remaining stationary and the work swinging about it. "Ball pointed" drills and reamers were used with their shanks reduced sufficiently to prevent their touching any part of the hole and deflecting their points.

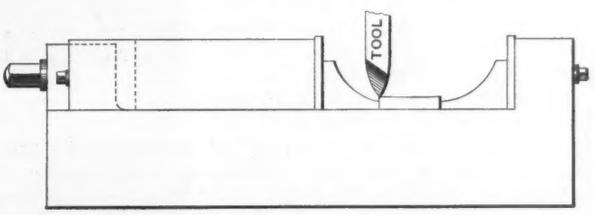


FIG. 6.

For the sake of clearness I have not drawn the sketch to scale, but it explains the whole thing better than words.

The needle had to fit the hole closely, and some may think that the difference between a straight hole through a piece one-quarter of an inch thick, and one drilled on a radius of 1¼ inches, would not be enough to notice; let them try it, fit the pieces as closely as the Eppler people do, harden them, and then attempt to revolve the needle, at the same time working it back and forth through the hole.

Triangular Parallels.

Time is frequently wasted in an endeavor to find just the right combination of parallel pieces to use in a planing or milling machine vise. Pieces of straight, smooth shafting or wire will often be found more desirable than the parallel strips provided in many shops, but two "triangular" parallel pieces have points of advantage that machinists seldom consider, and which have been suggested by Mr. John Prest, of Cohoes, N. Y.

By their use the work is held close to the bottom of the jaws, Fig. 6, where they are stiff, and the tendency of the vise to bulge up is practically removed. The shape of the parallels gives the tool room to traverse the entire top of the work, and the necessity of having a combination of parallel strips under the work of just the right thickness to bring the work to the top of the vise jaws is done away with.

A. L. G.

COST OF REMODELING AN OLD FACTORY.

W. S. Rogers.

"What will it cost to remodel our plant and put us on an equal footing with our competitors?" is a question asked by owners of factories who find their trade slipping away from them to the younger and more modern concerns with latest methods for doing work, and having plants designed especially for quick manipulation of materials and labor.

When they meet some neighbor who has gone through the ordeal of reconstruction, the question is again asked, and the reply, as a rule, is, "It cost a lot and enough more; we had to do it; did not want to do it; did not keep any record of the cost, because it was too much like throwing money away. It is one of those horrible nightmares that one wants to forget with all possible haste. But we have a fine shop now; you should see it." And so the problem stands unsolved. The questioner goes back to his old plant, gazes at the heirlooms of antiquity to be found on every side as he passes through, and in seven cases out of ten decides to even matters up by reducing the wages and employing cheaper help, and pray to Providence to send some miracle his way. The miracle never comes, but judgment day does, and it is recorded on the books of commerce that another old and tried concern has "retired" from business owing to the sharpness of modern competition and cutting of prices, etc.; while in truth "the corpse cut his throat while insane" would be the proper verdict.

It might be well to say right here, also, that there are many modern plants scattered about the land that need reconstruction and rearrangement to a greater degree than some of the ancient ones. This is brought about by the designer's desire to have the new plant as near like the old one from which he was taken as possible, "because it was so comfortable there." "Excelsior" not being the seed sown, early decay is the harvest fruit.

The writer has had the good fortune (or misfortune, as you choose to call it) for several years of revamping old factories, and some that were not so old, and rearranging their equipments, methods and systems on up-to-date plans; but not until within the past two years has he been able to obtain the real cost of such work and also secure data of the actual gains from reconstruction as developed by the lowering of costs in producing without lowering the scale of wages.

It was also his good fortune to have, in this instance, the most discouraging plant it was ever his lot to enter. The camera having failed to show conditions, a pen picture will suffice: As we approach the place we see it is a five-story and basement building, each floor 35 feet by 80 feet, with a two-story and basement annex, 80 feet by 80 feet deep. The front of the place is covered with advertising, until it resembled a crazy patch quilt. Entering the first floor, we find the shipping department a mass of gloom; on this floor in the annex are carpenters, machinists, wood-working machines, lumber, castings, completed and second-hand machinery mixed up promiscuously. A continual war exists among the workmen because they crowd upon each other. The packers bring their lumber here to saw for crating, and should the carpenters be "ripping" stuff, everybody waits his turn; if the packers are "cross-cutting" stuff for crating, the other men wait; scrap lumber, shavings, mixed odds and ends are piled here and there for the men to wade through, and everywhere is gloom, black ceilings, dismal posts, dirty walls and grimy windows. Down in the basement of the main building is the engine in one corner, with the boiler under the sidewalk. The engineer, with a pride that shows his association with the N. A. S. E., has endeavored to keep this corner of the place in decency and order. Under the stairway in this room is an old-time planer with a cutting speed of 15 feet per minute, while modern tools of the same size on the class of work it is doing will stand 38 feet per minute. Here are also two large lathes, 36 inches and 52 inches swing, with only 4 feet distance between counters and cones. All work must be lifted by brute strength into centers.

In the basement of the annex, as our eyes grow accustomed to the general gloom, we find men working on lathes. Nine of the lathes stand at right angles to the line shaft, and are driven with compound mule pulleys. Castings and scrap heaps against the black walls reinforce the blackness of the ceiling, and what light comes through the rust-stained windows gives a ghostly coloring to the whole place. Along the walls and in the black corners of this place are thousands of pounds of antediluvian castings being "saved" by the firm, in the hope that some day they might build something whereby they could be used. Taking the elevator to the second floor of the annex, we find a place fenced off, called a tool and stock room. Back of it is the sanctum sanctorum of the pattern maker, where all new ideas are invented; and to the right of the tool room built on the roof is a long, narrow room, full of dirty windows, called by courtesy the drawing room; here also is the superintendent's desk, covered with greasy waste, old paper and scrap stuff. Take the elevator again to the third floor of the main building (we will visit the second floor last), and it is a continuation of machine shop on the succotash plan. On the fourth floor are the sheet metal workers. Here also is the blacksmith and tool dresser for the workers in the basement and lower floors. Here are a man and a boy punching holes with a hand punch and doing in one day the same amount of work a competitor does in ten minutes. The competitor's machine cost $400; this hand punch cost $20. On the fifth floor we find the painter in the midst of stored goods, relics, misfits and general desolation, trying to cover all the evils in manufacture with the paint of benevolence without any "filler." Of course it is a failure. Lastly we go to the second floor, used as general offices and showroom. What a contrast! Fine hardwood partitions, glass panels, oiled floors, clean windows, and even the luxury of a graphophone, with all the latest songs of the day, to soothe the sorrows and vexations of business, while the old manufacturing cow, made up of engine, shafting, pulleys, patched belts, maimed and crippled machines, was living in filth, and had been milked dry and left unfed for years—another case of "killing the goose that lays the golden eggs." This is but a poor pen picture of the conditions

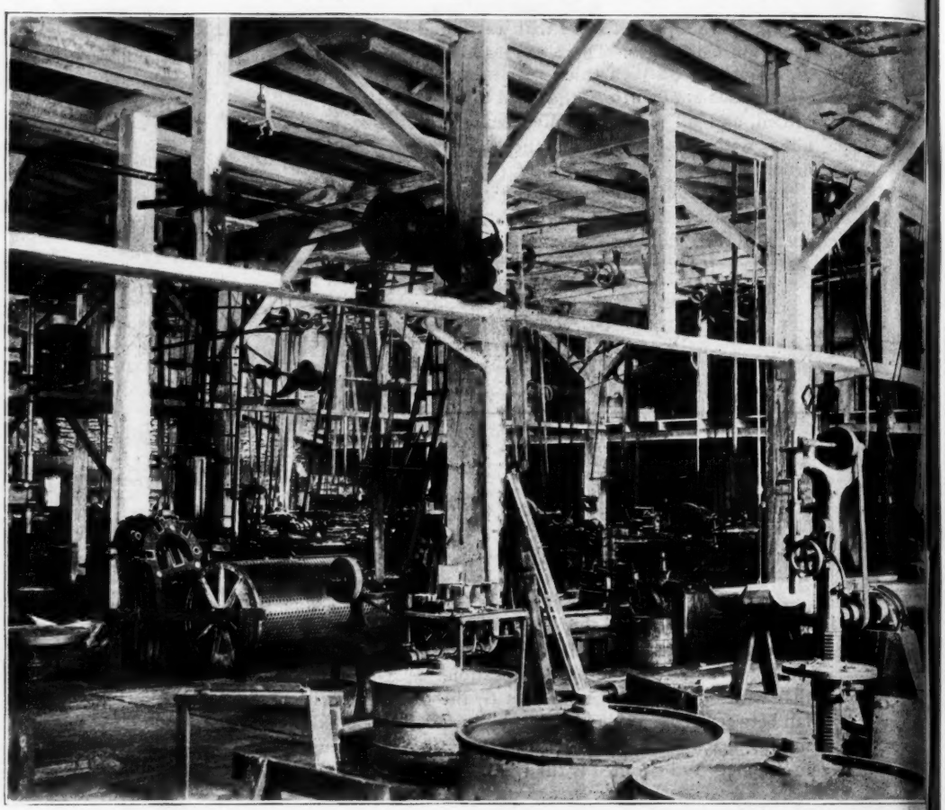
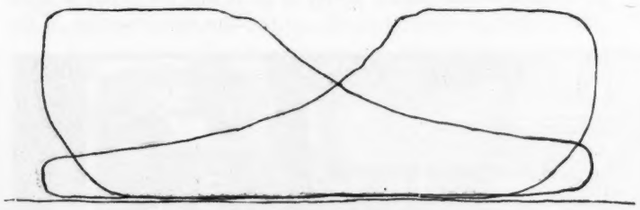


FIG. I. A VIEW IN THE MACHINE SHOP.

as I found them, so far as equipment and plant were concerned. The help I found without discipline and had naturally grown careless—their employers did not care, why should they? The president of the concern had acted as superintendent for two years, the greater part of his time being spent in Europe, at social functions and "inventing" impossibilities in mechanics. Any and everybody gave orders from the purchasing to the shipping clerk



INDICATOR CARDS TAKEN BEFORE REMODELING.

and office boy. The system of cost-keeping told everything, all things or nothing, as one chose to manipulate it.

In my arrangement with the company, it was stated that I was "not to do any designing of machines or inventing, but to manage the help, increase the output and decrease the cost without making any material changes"—another case of "expected miracles," or like buying a watch dog and then extracting his tongue and

FIG. 2. A CORNER OF THE ERECTING FLOOR.

teeth. The first thing to be had was thorough discipline among the help and energy and enthusiasm put in them, and while this was developing, to carefully study the best plan of reconstruction of equipment—not as I had done it elsewhere or as some other one had, but as conditions would best permit.

About this time I was asked for an opinion as to how I found things, and the following items are abstracted from my report:

OBSTACLES PREVENTING ECONOMICAL MANUFACTURE.

Machine shop cut into four isolated sections.

Sheet metal work split into two isolated sections.

Wood-working machines running at half their capacity.

Tool dresser five floors from the men who need him most.

Tool room two floors from the men who use it most.

Valuable producing space used for promenades and storage.

Twenty-five per cent. of coal used under boiler wasted driving antediluvian twist and quarter-turn belts, useless pulleys and shafting.

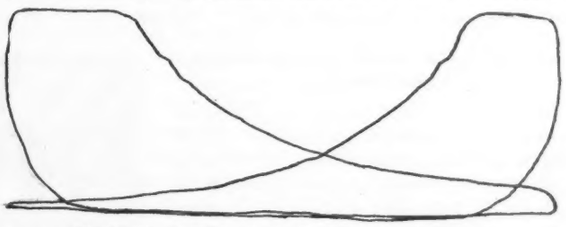
One third of the highest priced mechanics' time occupied doing laborers' work and handling and rehandling materials.

Files, hammers and chisels the principal implements used to work with.

Not a lathe center within 1-32 inch of truth.

Not a lathe pulling a decent cut.

Not a true or even respectable mandrel or arbor to be found.



INDICATOR CARDS TAKEN AFTER REMODELING.

Not a properly forged lathe or planer tool about the place.

No jigs or fixtures for saving time or money.

Not a single machine located according to the eternal fitness of things.

Belts mostly made up of laces and patched pieces.

No complete drawings of any machine.

Everything constructed on the "chop and fit" plan.

Sanitary facilities horrible; five and six men waiting for closets at once.

Every hole and corner a receptacle for dirt and spoiled materials.

Total lack of fire protection.

No system, method or discipline about the entire place.

Patterns built on the "compounding" plan to save first cost.

Superintendent's office in worst possible place, and looks like a Chinese laundry.

When ready for reconstruction a change in the board of directors gave them a president who was a man with years of experience in manufacturing. He went fully over my plans and inquired the cost and time required. When told the cost would be $3,500, the time three weeks, stopping the output and crippling manufacture, or four months without disturbing constant output, he simply said: "Do it the latter way, then we can double our output." This is always the better plan, unless the business is so utterly dead that orders for shipment do not have to be cared for.

Foremen over each department were created from the ranks and thoroughly initiated into the plan, with instructions as to what work to crowd ahead that other departments might not be idle while machines were being changed. The men became imbued with the fever, as they realized that they were to change from "sweat-shop toilers" to factory operatives, and worked with new zeal, and here is the result:

COST OF TIME REQUIRED AND LOST.

Moving sheet metal department and blacksmith from fourth floor to basement	703¾	hours,	$95.00
Moving eleven lathes and planer from basement to first floor	1,348	"	232.72
Moving five drill presses and erecting department from third floor to first floor	358¾	"	53.06
Moving stock and tool rooms from second floor to first floor	377¾	"	59.74
Moving wood and carpenter shop from first to second floor, drawing room to third floor, and altering pattern shop to second floor	1,660¾	"	254.07
Converting third floor into experimental room, and for erecting light machines	245	"	45.16

Building superintendent's office.....	114	"	25.68
Moving and altering shelving on all floors, and wash tanks, clothes closets, etc.....	1,251	"	203.29
Putting in shop telephone system....	165	"	33.00
Actual total hours and cost.....	6,114	hours,	$1,001.72
Value of time lost in manufacture.	6,114	"	1,001.72
Net cost in time and money.....	12,228	hours,	$2,003.44

MATERIALS USED AND OUTSIDE EXPENSES.

Lumber, etc.....	$385.00
Belting and lacing.....	136.00
New pulleys.....	64.00
Girders and trusses.....	40.00
Batteries, bells, wire, etc.....	17.00
Riggers contract.....	30.00
Small travelers and hoists.....	200.00
New tools.....	875.00
Rewiring electric light system..	165.00
Net $1,912.00	
Net cost of hours.....$2,003.44	
Total $3,915.44	
Gains taken from premiums and time cards for one year.....$4,348.96	

Twelve mule pulleys and 110 feet of shafting were thrown out. No record was kept of belting that had been abolished. The fourth and fifth floors were used for storage of finished product, being a clear gain of 3,200 square feet. The gain in manufacturing space was 3,580 square feet. The saving effected in the furnace room is shown by the indicator cards appended, which speak volumes.

Machines that before required a month to build can now be completed in ten days, easily. Others that required two weeks' time are now completed in one: work in the 42-inch lathe that formerly required six and seven hours is now done in three and four; the high-priced mechanics that formerly spent half their time lifting and lugging work from place to place now spend it in fitting and joining things in place; work that formerly had to be sent to and from different floors is now completed right where the machine is built.

The accompanying engravings show conditions after reorganization in three of the departments:

No. 1 is a part of the machine shop showing the grouping together and crowding of machines to gain free floor space. So closely were they placed in some instances that the driving belts of the lathe counters were operated from separate jack shafts.

No. 2 shows a portion of the machine erecting floor; the trusses under the ceiling in the picture were placed in position before the wood-working machinery was put in motion above, as the old decayed floor sagged in some places as much as four inches when loads were transported over it.

No. 3 illustrates another portion of the machine shop, showing what might be termed a "tool room." The small stairway resembling a step ladder, on the right of the picture, leads to where the stock room was located, this being the only instance known to the writer where a stock room was hung on a shelf.

No. 4 shows a portion of the wood and carpenter shop. This room was formerly devoted to stock, tool room and pattern shop; after the finish, the pattern makers were moved to the room previously occupied by the draftsmen, who were moved in a nice, cleanly painted room with plenty of light and air on the third floor. The superintendent's headquarters were located directly between the shipping and manufacturing departments. This position was the hardest to locate and decide upon of any, owing to its peculiar duties and importance and keeping in touch constantly with every point in the factory. The only department that was not reconstructed or altered was the pipe shop, which could be used for no other purpose and was undoubtedly built for a pipe shop.

The one great helper in this work was whitewash and the spraying machine. Owners of old factories covered with ages of soot and smoke have no conception of the great advantages and economy of these machines for brightening walls and ceilings and sweetening the atmosphere surrounding their employes while at work. There are hundreds of plants dying of dry rot from the fear of that bugbear "awful expense" in making alterations, when in truth it is like finding money to do it, and the outlay is more than gained in a twelvemonth. It requires determination of the

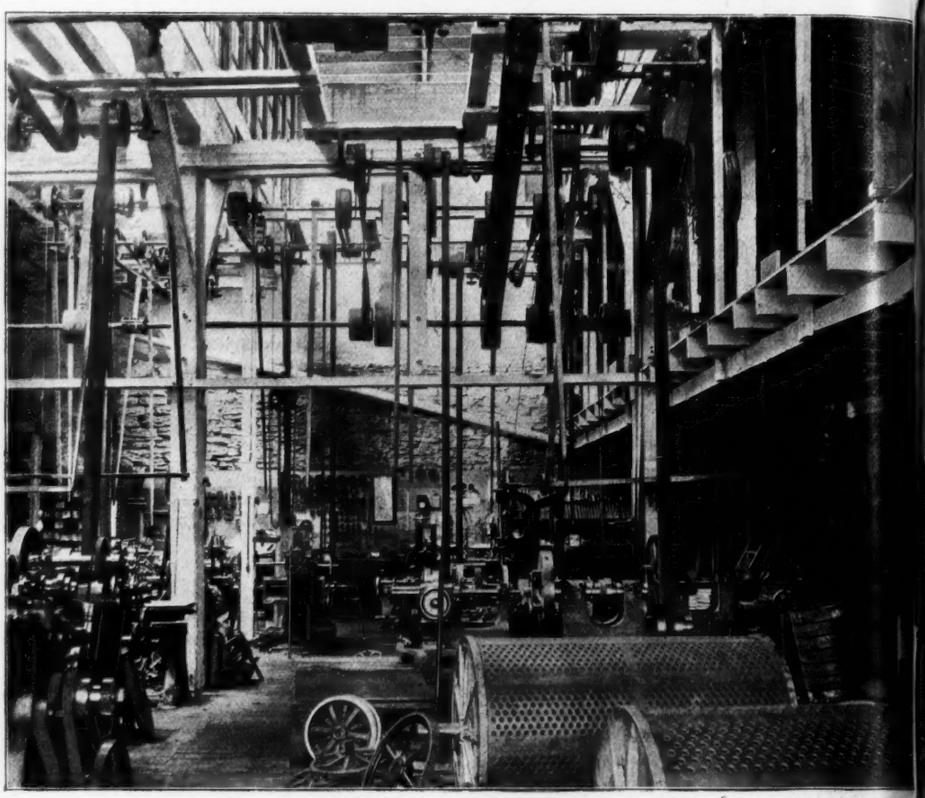


FIG. 3. ANOTHER VIEW OF THE MACHINE SHOP.

owners to be superior to all others, and a superintendent or engineer without a particle of sentimental, technical twaddle or fear, but with a cold-blooded idea of the commercial side of his employer's dollars, and who can make both ends meet with nothing in the middle.

* * *

COMPARATIVE VALUE OF TEST BARS.

THOMAS D. WEST.

The very interesting article on the value of test bars and their relation to casting, which appears in the February number of MACHINERY, by Mr. Herbert E. Field, contains much that requires straightening out. First of all he says "It has always appeared to me that this controversy over the merits and demerits of the ½-inch square bar and the 1-inch square or round bar has been an instance of the one stopping his ears while the other talks, and vice versa."

The closing of ears cannot be charged to advocates of one inch or larger bars, but to those laboring to maintain the use of ½-inch square bars, nothing has appeared that is more fitting to express the stupidity with which ears have been closed to facts demonstrating the impracticability of trying to use bars as small as half an inch square to make tests of the comparative strength of cast iron. If any desire proof to sustain this statement the writer can give it to them.

Mr. Field's comments on the advisability of measuring and taking note of the least variation in the area of bars at their point of fracture are well made. This is a feature which the writer has advocated for practice in all cases where accurate tests are to be made. It is desirable from the fact that, as Mr. Field states, no two bars can be cast from the one pattern that will measure alike in area at their points of fracture. In some cases bars may very easily differ in diameter or the square, from one-eighth to one-quarter of an inch, from others that have been

moulded from the same pattern. When we consider that even the slight difference of one-sixteenth of an inch in the cross section of a bar, when reduced to strength per square inch, can make a difference of from 200 to 400 pounds or more, the importance of taking note of the least difference in the area of test bars, moulded from the same pattern, should be evident to all. In cases where the best work is not exacted in securing strength records, several bars may often be averaged to render comparisons. Where it is not possible to take the average of several bars, and one is to be relied on for furnishing the comparison, then in most cases it is very desirable that note be taken of the least difference which may exist in their areas, from the area of the pattern from which they were made.

As to the value of tensile tests, the writer would strongly support Mr. Field's views, and admires the point he makes on all rectangular bars developing marked weakness lines in cooling, which, of course, is an endorsement of round forms of test bars, which present the most uniform texture or grain throughout the area of a test specimen. While the tensile test is a valuable one, the writer would not go to the length Mr. Field has in implying it was superior to transverse tests. It is true many have wholly ignored tensile tests and advocated the transverse test as being the one most suitable for testing cast iron, but this the writer does not indorse. The tensile test has its place as well as the transverse, and the writer often likes to carry both together, for, as a rule, one can be a check upon the other to assist in establishing confidence in the records obtained.

FIG. 4. THE WOOD AND CARPENTER SHOP.

That part of Mr. Field's article under the head of "Test Bars vs. Castings," the writer considers as not being a practical treatment of the subject. The first point to be criticised is that where he starts off with saying that "the tendency of to-day is to aim to get iron test bars strong, regardless of the other qualities of iron which go to make up the perfect casting." If founders accepted this as a rule to work by in making mixtures of iron, over half of the castings desired to-day would be impractical of construction. There are no two different classes of castings but that require a different grade of iron. One may permit of the strongest iron to make the casting durable under its work or usage, while the other might give the greater service if made of a weaker iron. The first thing to learn is the grade of iron that is best for your special casting. When this is known you are then in a position to establish the best standard for strength in that particular work, but such a standard is not of the kind Mr. Field suggests in his lines which read "The first, and it is preferable when possible, is to take a test out of some representative casting which has been rejected on account of a defect." How is any one to know if the iron in such a first rejected casting is the best for that special work? Castings which have never been used or put to the test of actual work, cannot best establish any record to demonstrate that the grade of iron comprising it is the best kind of iron for that special make of casting. It is to be understood, of course, that this refers to castings of which others of the same kind have never been tested to furnish records whereby comparison of its iron could be made in order to know what physical or chemical qualities the rejected casting might have possessed. If Mr. Field had said to take a test bar out of any casting that had given good service, and after testing it analyze it chemically, he would have hit the mark.

It is true, as Mr. Field implies, that in this day of strong competition it is very desirable to have castings that require machining as soft as practical, so as to save expense in finishing, but the manner in which he refers to castings not requiring high strength should be modified. There are very few castings in which high strength is objectionable. In fact, it is a very desirable quality to have exist wherever it can be combined without injuring the durability of castings. It is for this reason that we see pride taken by conscientious founders to obtain as high strength in their specialties as conditions will permit. To tell if with strength we are also obtaining softness is where the transverse tests have an advantage over the tensile tests, as through the transverse tests we are able to obtain a knowledge of the softness of iron. For this reason all published accounts of strength records should be accompanied with that of deflection. Wherever we find these two combined we can then form very fair opinions as to how much of the softening qualities have been sacrificed to secure the boasted high strength which Mr. Field refers to, and which, as a rule, founders are justified in laboring to obtain, notwithstanding Mr. Field's claim to the contrary. Did many buyers of machinery but know it, they ofttimes accept castings so "soft rotten" that the least unintended jar or shock will cause them to crack or go to pieces in a manner to hazard life or property.

Continuing, Mr. Field says, "The second method is to cast a test in the casting of such shape and in such a position as will best give the true strength of the casting." "This is the only method that can be used when the strength of a specific casting is desired." If Mr. Field desires to obtain the strength of a specific casting, there is but one way, and that is to subject that particular casting to actual usage, or to an appropriate test, which might include hydraulic pressure or that of a drop weight falling on the casting, after the plan used with testing car wheels. The varying proportions of castings and the difference which exists in the ratio of their parts cooling off, combined with the possibility of the existence of sand, blow and shrink holes, are several of the qualities that go to make it impractical to cast test pieces with castings as suggested by Mr. Field to truly define their strength. All that the founder can do in making castings to permit judging of their strength (if not tested by hydraulic or the drop, as cited above), is to make test specimens that will be cast out of the same iron with which the casting is poured, to give him a knowledge of the physical qualities of the iron that goes into the casting. After a casting has demonstrated its durability by usage, then by referring to the mixture used, the founder is best enabled to duplicate a like durability in a like casting, and this is where the utility of the test bars comes in, as it permits making a com-

parison between two mixtures, to learn whether or not there exists any physical difference in them. By the adoption of such a standard test bar to guide him, he is then best assured that if he can duplicate a mixture that has proven good by use in some specific casting of the past that any further casting made from the same pattern and mixture is most liable to withstand a similar usage.

A test specimen of the form and size to be the least affected by any variation in the nature or dampness of sand, also by variations in the degree of the metal's fluidity, can be used for a standard comparison, whether made with the casting or poured separate with the same iron after the manner usually adopted in the casting of test bars. This is not saying that when test specimens are made with a casting, as suggested by Mr. Field, that they will define the specific strength of that special casting. Their utility lies in their fitness for making a comparison with records of mixtures that may have been previously used as implied above. Before a comparison can be made to permit our judging of what physical qualities may exist in a specific casting, two or more of such castings must have been previously made at different "heats" and tested as cited above, a study of which quality should clearly define wherein Mr. Field has failed to comprehend the true utility of the test bar, and is wrong in claiming that the only method to obtain the strength of a specific casting is to rely on the records secured from a test piece cast in the same mold with the specific casting, regardless of there having been any previous tests recorded of a similar mixture (as implied by Mr. Field's article), whereby comparisons could be made.

There are so many places in Mr. Field's paper that show that he has failed to grasp the true utility of test bars, one is at a loss what passage to select. Further on he says "That the plea for a universal uniform test bar is an absurd proposition," and says, "The one fact that it is possible to pour from one ladle of good iron a series of tests which shall vary from 15,000 to 27,000 pounds tensile strength should show this." To prove this he asks all to make test pieces of varying sizes, which he means shall be poured from the same ladle and reduced to strength per square inch. Any founder of experience in heavy work knows that if different sections or sizes of test bars are used varying results in strength, etc. records are to be expected, partly because the state of the combined carbon cannot be alike in two bars of different section or area, due to the variation in the thicknesses of their bodies causing one to cool faster than the other. This is no argument to be used against the adoption of a universal system of tests and is an impractical solution of the problem, and goes to show that instead of Mr. Field accusing others of not having thought deeply, as stated in his last paragraph, he should accept the censure for himself.

* * *

STEAM CALORIMETERS.

THEIR CONSTRUCTION, VALUE AND USE TO THE ENGINEER.

A. H. ELDREDGE.

In all engine or boiler tests the amount of dry steam used per horse-power, per hour, is one of the principal items to be determined. By dry steam is meant steam that contains no free moisture and is not superheated. It is in that critical state where, if some of its heat should be withdrawn, part of the steam would at once condense to water, or, if more heat were added, the steam would be superheated.

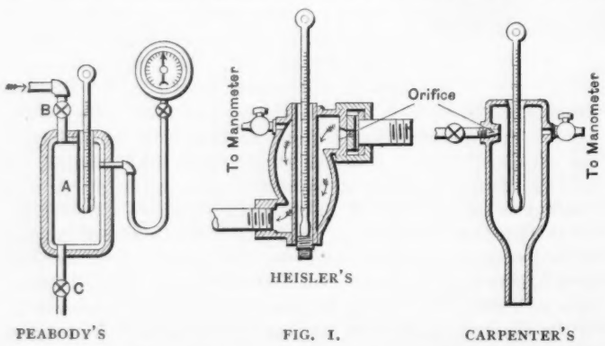


FIG. 1.

In order to find the amount of dry steam present in a sample of steam, we have to know its quality. This can be determined by calorimetry tests.

Two of the principal forms of calorimeters for determining the quality of steam will be presented here. One, the superheating or throttling calorimeter, the other the separating or condensing calorimeter. The throttling calorimeter was invented by Professor Peabody in 1888. It consists of a chamber (*A*), Fig. 1, having an inlet valve (*B*) and an outlet valve (*C*), with gauge and thermometer connections as shown in the figure. The pressure within the calorimeter can be kept at any desired amount by regulating the inlet and outlet valves.

The next form of throttling calorimeter shown in Fig. 1, and known as Heisler's calorimeter, differs from Peabody's in shape and in that it has a small, throttling inlet orifice and a free exhaust, as shown in the figure. Professor Carpenter's throttling calorimeter differs from Heisler's in form only. It also has a throttling orifice, but is much simpler in construction. The method of using or of working up the results is the same in each of these instruments.

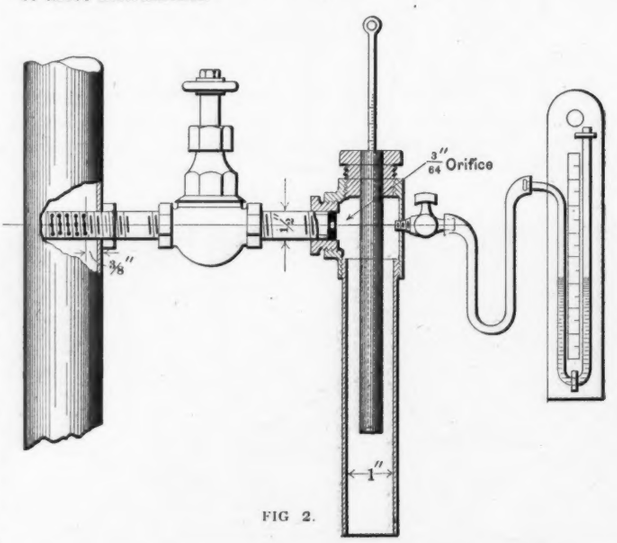


FIG. 2.

Before going further let us see what disposition is made of the heat in a pound of steam. Starting with a pound of water at a known temperature we will have to add a certain amount of heat to bring the water to the boiling temperature corresponding to the steam pressure. That amount of heat is known as the sensible heat, or the heat of the liquid, and affects the reading of a thermometer. Next we must add more heat in order to convert this hot water into steam at boiler pressure. The latter amount of heat will not affect the reading of a thermometer, and the temperature of the steam and water will remain the same so long as the pressure is kept constant. This heat that cannot be measured by a thermometer and disappears as the water turns to steam is known as the latent heat of steam, so that we have as the total heat in a pound of steam, the sensible heat plus the latent heat of the steam, or

$$H = x r + q, \qquad \text{(I)}$$

where $H =$ total heat in a pound of steam,
$x =$ the quality.
$r =$ the latent heat,
$q =$ the sensible heat or heat of liquid.
All figured from 32 degrees F.

If we look at the steam tables we find that the total heat in a pound of steam at 100 pounds' pressure is greater than that in a pound at any lower pressure. Herein lies the secret of the throttling calorimeter. Referring to Fig. 1, we can see that steam is allowed to escape from one pressure into the calorimeter at a lower pressure without doing work. As the steam at the lower pressure, in its normal state, does not contain as much heat as it does at higher pressure, what becomes of the surplus heat as the steam escapes from the higher to the lower pressure?

First—It goes to evaporate any moisture in the steam, and

Second—It superheats the steam, so that we have the total heat in the steam before entering the calorimeter equal to the total heat after it enters the calorimeter; or,

$$x r + q = \lambda + .48\,(t' - t) \qquad \text{(II)}$$

Where $\lambda =$ the total heat in a pound of steam having a quality of 100 and .48 equals the specific heat of the steam, t' equals the

observed temperature of the steam as read by the thermometer in the calorimeter, and t equals the normal temperature for the pressure in the calorimeter, as found by the steam tables. The values x, r and q are the same as in equation I.

The pressures should be absolute pressures, that is, the barometer reading should be added to the guage readings. Where this cannot be obtained we can assume 14.5 pounds as the barometer reading and add that to the guage readings without sensible error.

How to obtain a fair sample of the steam is one of the most difficult problems in Calorimetry. A collecting nipple placed in a vertical pipe, as shown in Fig. 2, is one of the best methods used. The nipple should extend about three-fourths of the way across the pipe, and should be perforated with small holes. The holes should not come within ⅜ inch of the side of the pipe from which the sample is taken. Avoid horizontal pipes where possible, and never take the sample from the bottom of a horizontal pipe.

A very good throttling calorimeter can be made from pipe fittings, as shown in Fig. 2. Where the exhaust of the calorimeter is open to the air, a rubber cork can be used in place of the thermometer cup, and the thermometer can be inserted directly into the steam. Where a thermometer cup is used, it should be filled with cylinder oil. A mercury manometer can be used to get the

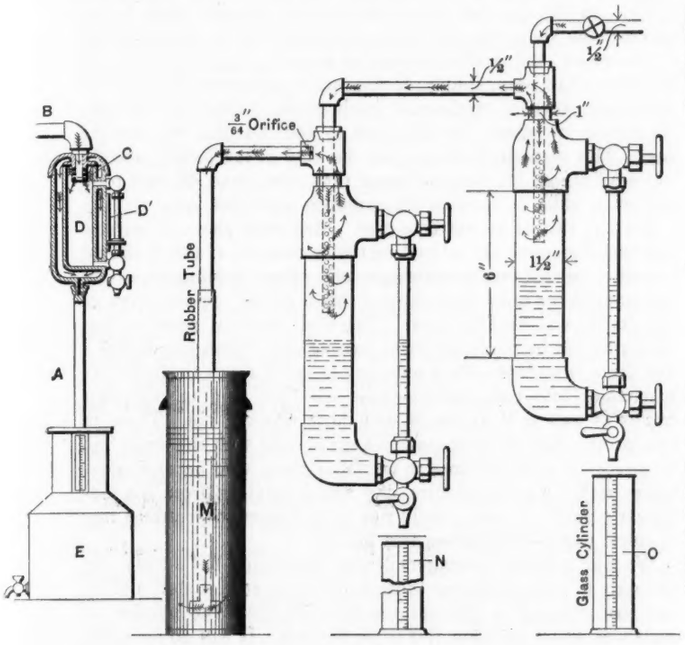


FIG. 3.

pressure within the calorimeter. The scale of the manometer can be graduated to read in pounds pressure, or in inches of mercury. One inch of mercury equals .49 of a pound pressure.

We are now ready to use the instrument, and should take the following readings: Steam-pipe and calorimeter pressures and the calorimeter temperature. From equation II. we can find the expression for the value of x.

$$x = \frac{\lambda + .48\,(t' - t) - q}{r} \qquad \text{(III)}$$

Let us find the quality of steam from the following conditions:

Steam pipe pressure, gauge 90 pounds, absolute, 104.5.

Calorimeter pressure, gauge 1.5, absolute, 16.0.

Temperature of calorimeter, observed, 240° F.

Normal temp. of cal. at 16 pounds absolute pressure, 216.3° F.

*Total heat of steam λ for 16 pounds absolute pressure, 1179.9 B. T. U.

Sensible heat q for 104.5 pounds absolute pressure, 334.2 B. T. U.

Latent heat r for 104.5 pounds absolute pressure, 880.6 B. T. U.

Place these values in equation III., and we have

$$x = \frac{1179.9 + .48\,(240. - 216.3) - 334.2}{880.6}$$

$$= \frac{867}{880.6} = .983 \text{ or } 98.3 \text{ per cent.}$$

This shows the steam to be 98.3 per cent. dry, or to contain 1.7 per cent. of moisture.

The throttling calorimeter can only be used where the quality of the steam is comparatively good. In other words, where there is too much moisture in the steam to be re-evaporated after it has passed into the calorimeter or where $t' = t$, then we cannot determine the quality by means of the throttling calorimeter. Where the steam is in this condition, save in special cases, as the exhaust of an engine, a steam separator should be placed in the steam-pipe to separate the moisture from the steam. .

Where the amount of moisture in the steam is too great to be determined by means of the throttling calorimeter, the separating calorimeter as devised by Prof. Carpenter can be used. This calorimeter is really a small steam separator in which moisture is separated mechanically from the dry steam and measured, while the dry steam passes into a condensing chamber, and is condensed and measured. This instrument can be used for practically any amount of moisture. Carpenter's steam-jacketed separating calorimeter is shown at A, Fig. 3. In this instrument the steam enters at B. The moisture, being separated mechanically from the steam, is retained in the inner chamber, and the amount is measured on the graduated guage glass, as shown at D'. The dry steam passes up through the openings at C and then into the outer chamber of the calorimeter, steam-jacketing the calorimeter, and down into the condensing tank E, where it is condensed and measured. The calorimeter being steam-jacketed, we do not have to correct for radiation losses, and the quality of steam will be:

$$x = \frac{\text{weight of dry steam}}{\text{total weight of steam used}} = \frac{W}{W + w} \qquad \text{(IV)}$$

W = weight condensed in E.

w = weight measured in D.

As an example, let $W = 1.10$ pounds, and $w = .18$ pounds. What will be the quality of the steam? Substitute in equation IV.

$$x = \frac{1.10}{1.10 + .18} = .859 \text{ or } 85.9 \text{ per cent.}$$

A separating calorimeter, made of pipe fittings, is also shown in Fig. 3. In this calorimeter the surfaces are exposed to the cooling action of the air, so that a certain amount of steam is condensed and added to the weight of the moisture coming over with the steam. This is what is known as the radiation loss of the instrument, and has to be corrected for. The radiation loss is corrected for by connecting two calorimeters of the same size as in Fig. 3. Then, as only dry steam leaves the first calorimeter, the water collected in the second is due to radiation of that instrument alone, and we have for the quality of the steam:

$$x = \frac{W + 2R}{W + R + w} \qquad \text{(V)}$$

Where W = weight condensed in can at M,

R = weight caught at N,

w = weight caught at O.

Given: $W = 2.15$ pounds, $w = .35$ pounds, and $R = .03$ pounds. What is the quality of the steam?

In using this calorimeter we should take the tube out of M and let the steam blow through to warm the calorimeter up. Then start with a known weight of water in M, and with a thread mark the height of the water in each gauge glass. The water can be kept at a constant height in the calorimeters during the run by allowing it to drip into the glass cylinders below. These cylinders can be bought already graduated, or can be easily graduated to read in hundredths of a pound. Be sure always to start and stop with the water at a given height in the calorimeters, as shown on the gauge glass. Once the radiation loss is determined for given conditions, we can do away with one of the instruments, in which case the quality of steam would be:

$$x = \frac{W + R}{W + w} \qquad \text{(VI)}$$

The water in the condensing can should not be allowed to get hot enough to steam, and the can should be large enough to hold about three pails of water.

To the young engineer who desires to know how to conduct engine and boiler trials and the use of steam tables, few experiments are of greater value than these in Calorimetry.

* The amount of heat required to raise the temperature of one pound of water, one degree, from 39° to 40° F., is called one British thermal unit, usually written B. T. U.

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AMERICAN MACHINERY IS THE TITLE OF THE FOREIGN EDITION OF THIS JOURNAL, WHICH IS PRINTED ON THIN PAPER AND COMPRISES ALL MATTER IN THE DOMESTIC EDITION. THESE TWO EDITIONS AGGREGATE THE LARGEST CIRCULATION OF ANY PUBLICATION IN THE MACHINERY TRADE.

APRIL, 1898.

The offices of MACHINERY and THE INDUSTRIAL PRESS will be removed on the 15th of this month to 9-15 Murray street, near Broadway, where we will have sufficient room for the requirements of our business, which has largely increased during the past three years.

* * *

Americans have persistently clung to the use of the governor belt on large steam engines, while on the continent gearing is generally used. There are undoubtedly advantages in the flexible drive given by the belt; but the belt has also been the cause of innumerable accidents, and although safety devices are now used on all the best governors, they are of the nature of a remedy rather than of a cure. It is coming to be the practice to abolish belts and chains and to resort to positive drives on the better class of machinery. What are the objections to adopting this practice on the steam engine? We believe with Professor Sweet that a fair-minded engineer must be ready to gather information from any quarter of the globe where mechanical men have been at work.

* * *

If a bearing is well made, of ample proportions, and is kept oiled, it will wear a long time without adjustment. If the machine is in the care of machinists, it is generally safe to use adjustable bearings with almost any form of adjustment that is rigid and strong. But where a machine is liable to fall under the care of anybody and everybody, the best rule seems to be to make the bearings of generous proportions, and to make them either solid or with split boxes which can be adjusted only by removing the top box and filing off its lower edges, an operation not likely to be indulged in except in cases of extreme necessity. If the bearings are to be solid, provision for wear can be made by using brass bushings which can be replaced at any time. This method is good in theory and works well in practice until the day arrives for renewing the bushings. Then it will probably be found that the holes for the bushings are not standard size and must all be calipered and the bushings turned after the old ones have been removed, which keeps the machine standing meanwhile. It will also be generally necessary to bore the new bushings smaller than standard size, to compensate for the wear of the journals, an operation that is far from rapid compared with chucking standard holes with standard drills and reamers.

After all, a very satisfactory adjustment for a bearing, to whatever use it is to be put, can be had by using thin metal shims between the two boxes. Removing one or more of these and bolting the box down solid again does not require a great amount of care or skill. Shims also afford a fairly satisfactory means of taking up the wear of gibs, although they are not so convenient as some other systems. Probably the most satisfactory take-up for sliding bearings, as well as the most expensive, is the taper gib; and the least satisfactory, although the most commonly employed, even on high-grade tools, is the gib set up by means of set-screws.

* * *

FOR READING MECHANICS.

"The more a man knows, the less he is worth, and I don't want any reading mechanics to work for me."

This, in effect, is one of several similar remarks made by an enterprising shop manager in conversation with a representative of this paper, and in the presence of several of his employés. If the intent had been, simply, to express a preference for some of the other excellent mechanical publications instead of our own, we should, of course, have no fault to find; but this was not the case. This manager believed that the kind of mechanics who do not read served his purpose better than those who do, and took particular pains to impress his employés with this fact.

We cite this as an extreme case. Men with views so narrow and unprogressive are seldom met with nowadays, and it should in justice be said that conversation with others holding important positions at the same shop showed that a totally opposite view of the matter was held by them. There is, however, more or less antipathy felt by many practical men against "book knowledge," and there is undoubtedly a tendency in some shops to divide the mechanics into two classes—those who are paid to use their brains as well as their hands, and those who are not. Those in the former class are supposed to keep abreast with the times and to direct the work of those in the latter class, who become operatives rather than mechanics, and whose services, from the employer's point of view, would not be enhanced by reading mechanical papers or studying text-books..

We take it that all managers of men who read MACHINERY are strongly in favor of having those under them read it also, and we are strengthened in this opinion through the large number of instances where we know this to be the case. It will do no good, therefore, to address managers upon the subject under discussion. We will, however, offer a word for the benefit of the young mechanics.

In case there are any who have run against conditions similar to those mentioned above, which tend to discourage them in their efforts to read and study, we advise them to make themselves greater than the conditions and to keep at it. It will pay in the end; there can be no question about it, although the outcome for the time being may not be quite clear.

We are fully aware that reading, in itself, does not necessarily make good mechanics. We have known many good mechanics who never looked inside a mechanical paper. They were skillful, well-paid men, who could turn out a good job in a short space of time, and who were able to devise ways of getting around difficulties. But we often wonder whether such men would not have been better mechanics, have been earning more money, and perhaps holding better positions, if they had done some persistent reading in their chosen line of work.

Why should not this be the result? There are certain direct advantages that can be gained by reading a progressive mechanical paper. How many mechanics are there, that do not read, who can tell what the best practice is in any one line, what new tools are being introduced, and what systems of management are adapted to existing conditions? These are questions that have to be decided every day by those in authority and that count quite as much in such a position as the ability to turn out a good piece

of work at the bench or lathe. The average machinist is tied down. It is hard for him to get out among the shops to observe for himself, and he may have to work many years in different shops before he can pick up the information wanted—just the kind of information that a mechanical paper will bring to him.

How many times we hear machinists express the wish that they were "better at figures"! The figuring that is done around a machine shop is not generally of a very heavy nature, but there is a good deal of it that might be done to advantage first or last, and here again the right kind of a mechanical paper will prove a help. And not only this, it will tell the "how and why" of many things that continually come up. Then a great advantage that will be gained by the reading mechanic is that he will have the accumulated experience of hundreds of other mechanics in various departments of work. If a man digs out a problem, writes out his results and another man reads them, the man who reads can make that experience almost as valuable to himself as his own, and much more valuable than if it had been told him by word of mouth, because he has it in permanent form for future reference.

Probably of more importance than all, however, is the fact that the spirit which impels one to read and study is generally the same spirit that impels one to seek information elsewhere and eventually to achieve success. It is this spirit which shows itself in the apprentice at the lathe when he tries to master the change-gear problem, in the floor hand who studies out the gearing of the traveling crane, or the machinist in general who keeps his eyes and ears open and his brain busy.

It makes no difference how poor or how good the position, this kind of spirit will count, and one of the best means of cultivating it is to read, regularly and understandingly. It makes no difference what the outlook may be, or what discouragements may be met with, the reading habit should be formed. As we said before, our advice is to read and to keep at it.

* * *

ESTIMATING ON MACHINE WORK.

We have recently had two enquiries upon estimating. It is generally admitted that to estimate correctly is one of the most difficult as well as one of the most useful acquirements that a man can have. In machine construction this is especially true, and it may be added that it is also one of the most difficult subjects in which to impart information that will be of any value whatever to the person receiving it. Half the estimating that is done is nothing more nor less than a big guess, with 50 per cent. added for safety, and then the chances are that the figures will be too low. Nowhere that we know of can so clear a distinction be seen between "guessing" and "judgment" as in estimating. Close estimating can come only through using good judgment, and that can come only through experience. Guessing will not do.

In shops where pieces are often duplicated, or where work of a similar character is continually done, it is of great assistance to the estimater to have complete and reliable returns upon the previous work from the time-keeper. Too often the returns are not sufficiently differentiated to be of any value, or else the exact conditions under which the pieces were made, are not known. The returns should be in such shape that the time can be found for each operation on each piece; the number of pieces made; whether one man ran one or two machines, and which machines they were; what jigs were used; the name of the men who did the work, and the kind of stock used. All of these items are necessary to make the returns of real value as a basis for future estimates. With these data at hand it is often possible to formulate rules that will apply in any case of estimating that is likely to arise.

While rules may sometimes avail, however, the chief help to the estimater is a close and intimate knowledge of shop work. This does not necessarily imply that to estimate correctly one must be a practical workman (although that is an advantage), for we have known many workmen who could not estimate at all; but a man should at least be a close observer of methods and work in the shop.

On heavy work one's estimate can be based to a large extent upon the number of square feet of metal to be removed, because, in general, the time spent in machining is much greater than the time taken for handling and setting; but even here a knowledge of speeds, feeds, the number of cuts that must be taken, etc., is all important, and the shop knowledge is what counts after all.

This shop knowledge should not only be general, but it should pertain to the shop where the work is to be done, as well. It should embrace a personal knowledge of the tools, including their speeds and stiffness, a personal acquaintance of the workmen and their abilities, and a knowledge of the facilities for handling heavy pieces.

For the average work as it comes, our experience is that the only successful plan is to first make a complete list of all the parts that are to be made; second, decide upon the methods that will be used in making each piece and prepare a list of the operations; third, decide upon the time that it will probably take to perform the actual cutting; fourth, estimate the time that will probably be taken for getting the machine ready at the start, setting up and handling the work and grinding the tools. For the third and fourth items the previous returns may help somewhat, as may calculations; but not too much dependence should be placed on the latter where there are shoulders, fillets, grooves, etc., to be machined. If the weights have to be obtained, this is comparatively easy, of course, as, beyond gaining a familiarity with the methods, it is nothing more than solving examples in mensuration.

Having gone through with these processes, the final result, as we have stated, will depend entirely upon the good or bad judgment displayed. As the subject is both interesting and useful, we shall be glad to hear from any readers who can give information upon it that will be of benefit to others.

* * *

THE DRUMMER AGAIN.

The same drummer that climbed six flights of stairs to find he was the victim of a joke, (?) as described in a recent number of MACHINERY was trying, quite a while ago, to get a certain "purchasing agent" interested in his (the drummer's) machinery, arguing that the machine would save at least 50 per cent. over the hand work which the factory was then doing.

Of course the drummer expected a due proportion of snubs from the various persons whom he talked machinery to, but was knocked speechless when the purchasing agent (who was of the class of persons who "know that 99 cents is less than one dollar, and that is all they do know") said: "I wouldn't buy one of your d—— machines if it would save 100 per cent."

The drummer concluded that his presence was obnoxious to the purchasing agent, and made as dignified a retreat as possible, and hasn't been to that place since. He "didn't have to," as the sequel will show, but we anticipate, as the novel writers say.

The establishment which harbored Mr. Alexander Smart (the purchasing agent) belonged to a "combination to reduce manufacturing expenses," sometimes called a trust, and soon after the purchasing agent had his fun with the drummer, several of the employes of the place pulled out and started an independent factory to "buck against the trust," and about the first thing they did was to buy a machine of this particular drummer, but after a short time they sold out to the trust and went back to their original places.

The trust then had on hand this machine which the drummer had in vain tried to sell to Mr. Alexander Smart, and after a consultation by the trust managers it was decided that the machine should be placed in the factory with which Mr. Smart was connected, because this was the worst equipped factory in the whole trust. And the machine is now in the factory, and the drummer is smiling softly to himself and wondering what Alex thinks of it.

SLOW PAY.

* * *

"I have ever felt the want of it myself (technical education) and have admired it in others, but for all that I have a most kindly feeling for my 'alma mater,' the old-time country machine shop, of which to-day there lies not one stone upon another. Not one sodden timber rests in the forebay, and only the notched recesses cut in the rocks on the river bank remain to show where the old water-wheel once slowly turned on its well-worn gudgeons, and much as I admire the grand engineering schools of to-day, now that the hard toil of my youth is over, I look back to the old shop with a thankful heart that amid its grime and dirt, amid its hard work and unpaid services, I learned of patience, of perseverance, of self-reliance and handicraft, and above all I learned under most trying and discouraging circumstances to close tightly my lips together and inwardly vow that I would make it go somehow."—J. F. Halloway.

SHOP TALKS WITH YOUNG MECHANICS.—4.

SCREW THREADS, TAPS AND DIES.

W. H. VAN DERVOORT.

As to their uses, screw threads may be divided into two classes; first, those used for fastenings; and second, those used for communicating motion. The term "fastenings" is applied to any device used to hold together two or more pieces, either holding them rigidly together or constraining any relative motion between them. The important position that the screw thread holds under this head becomes forcibly apparent when we consider a machine, as a lathe, for example, and wonder how we would manage to hold its numerous parts together without the use of this device. The lead and cross feed screws in a lathe are examples of screws used to communicate motion.

In Fig. 42 are shown the three forms of threads used for fastenings.

In the V thread the angle of the sides with each other is 60 degrees, the top and root of the thread being sharp.

The United States standard thread, or as it is often called, the Sellers or the Franklin Institute thread, is the same as the V, with the top cut off and the root filled in. The amount taken from the top and added to the root is one-eighth of the height of the V thread, thus making the U. S. S. thread three-fourths the depth of the V thread. The U. S. S. form of thread was recommended by the Franklin Institute in 1864. This system was devised by Mr. William Sellers, and has become the acknowledged standard thread in the United States. Its points of superiority come from the fact that it does not cut so deep into the stock as does the V thread, thus leaving a stronger root, while the small amount cut from the top and bottom of the V thread has little strength value. It is more cheaply produced, as threading tools with flattened points stand up under their work much better than those with sharp points, and the filled root does not form a distinct fracture line as does the sharp root of the V thread. This form of thread is well adapted for interchangeable work, being used by the leading builders, and its complete adoption should be urged by all.

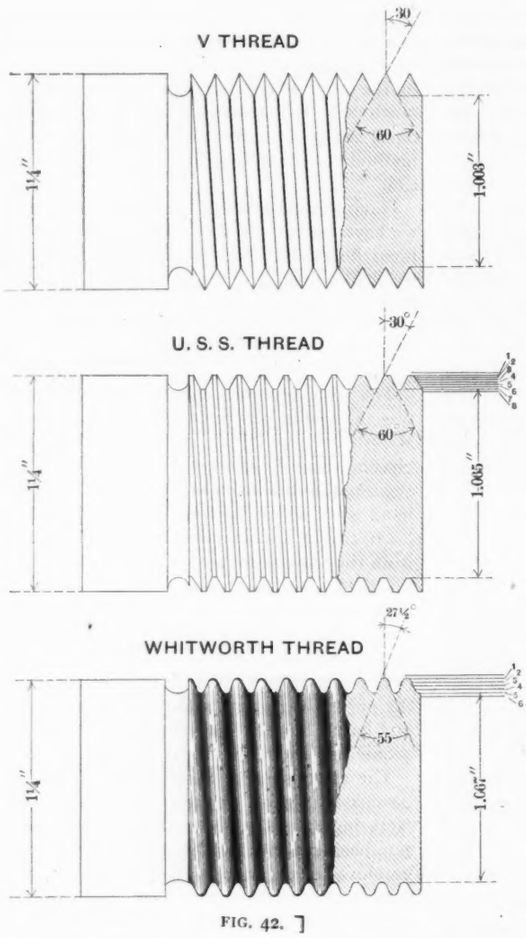


FIG. 42.

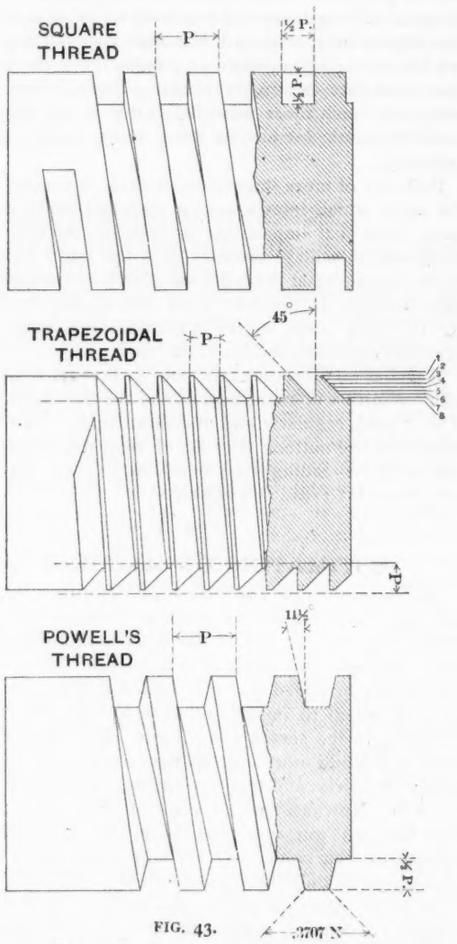


FIG. 43.

In the Whitworth or English standard thread the tops of the threads are rounded off and the roots filleted in. The angle of the sides with each other is 55 degrees, and the amount taken from the top and added to the root is one-sixth of the height of the V thread, having sides at a 55 degree angle with each other.

Each of the threads shown in Fig. 42 are to scale for standard one and one-quarter inch bolts, and the dimensions given will facilitate comparison.

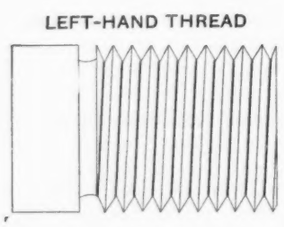
In Fig. 43 are shown three forms of screw threads used for communicating motion.

The pitch of the screw is the distance it advances in making one revolution; thus, the pitch of a screw having eight threads per inch is one-eighth of an inch. It is usual to refer to the number of threads per inch, rather than to the pitch. For example, in Fig. 42 it is seven threads per inch, rather than .143 of an inch pitch.

All screw threads may be either right or left handed. Fig. 44 illustrates a left hand screw. The left hand screw enters its nut by turning it counter clockwise.

When a steep pitch is desired and the diameter of the stock would be too small to permit the use of a single thread, two or more parallel threads, dividing the pitch into two or more parts, may be used. Such are known as double, triple and quadruple threads. A triple thread is shown in Fig. 45, with single thread of same pitch shown dotted.

The U. S. S. admits of no oversizes and specifies the number of threads per inch for each size, as well as prescribing the form of thread. For special work, however, it is frequently advisable to use a different number of threads per inch from that specified in this system, but such will, of course, not be standard, and must always be looked upon as special. The following table gives the principal diameters and corresponding numbers of threads, as determined in the U. S. S. system:



FIN. 44.

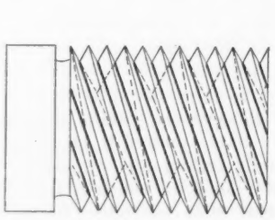


FIG. 45.

TABLE OF SCREW THREADS.

Diameter of Bolts.	Number of Threads per inch.	Diameter of Bolts.	Number of Threads per inch.
¼	20	1⅛	7
5/16	18	1¼	7
⅜	16	1⅜	6
7/16	14	1½	6
½	13	1¾	5
9/16	12	2	4½
⅝	11	2½	4
11/16	10	3	3½
¾	9	3½	3¼
1	8	4	3

The screw threads with which the machinist has to deal are produced by cutting processes, in which the thread is formed from the solid stock. Cut threads are produced either by means of a single pointed cutting tool or a chaser used in a lathe, or by means of taps and dies. In the first case the pitch of the screw being cut is dependent on the lead screw of the lathe, while in the latter case the pitch is dependent on the lead of the tap or die. Screws used for communicating motion, or where accuracy is desired, are cut in the lathe, while those used for fastenings are usually cut by the other method.

FIG. 46

FIG. 47

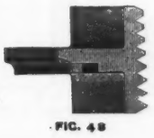


FIG. 48

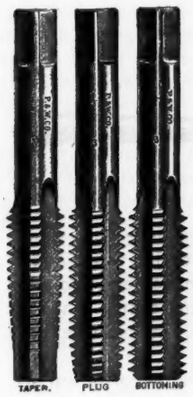


FIG. 49

FIG. 50

FIG. 51

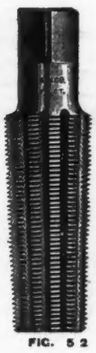


FIG. 52

FIG. 53

FIG. 54

The tap is a tool used to produce internal threads, and the die is a tool used in cutting the external threads. Hand taps and dies are those intended to be used by hand, while machine taps and dies are those operated by power in a machine.

Taps.

The hand tap is shown in Fig. 46. It should be made of a high grade steel, of a temper specially suited to the severe work it is called upon to perform. It is provided with a round shank, with milled square to receive the tap wrench. This shank is frequently turned to the exact diameter of the root of the thread, and used to gauge the final settings of the single pointed threading tool, with which the thread of the tap is finished, it having been previously roughed down with a chaser. This work is done in a lathe having an accurate lead screw, the accuracy of the tap depending largely upon this screw.

The tool used for finishing the thread must be very accurately ground as to the angle and then most carefully set in the tool post. In Fig. 47 is shown a threading tool admirably adapted to this work. It is correctly ground in the angle, and is sharpened by grinding from the top. It is so secured in the holder that it can be raised as the top is ground away. Cutters of this style in either V., U. S. S., or Whitworth threads may be had.

A form of chaser used in roughing down the threads of taps is shown in Fig. 48, and can be used in the holder shown in Fig. 47. These chasers when new have sharp 60-degree teeth, which should be chamfered as shown in Fig. 48, for cutting a right hand thread, and from the opposite side for a left hand thread.

Four grooves are ordinarily milled in the tap, thus forming four sets of cutting edges. The form of this groove varies somewhat, but has little effect on the cutting qualities of the tap. It is usually so formed as to bring the cutting faces of the teeth on a radial line, as shown in Fig. 55, and should be only deep enough to allow room for chips and oil when tapping deep holes. If the groove area is made too large the strength of the tap is seriously impaired. It will be noticed in Fig. 55 that the teeth are comparatively short, less than one-third of the circumference having teeth. The shorter the teeth the less will be the frictional resistance and the weaker will be the tooth. As tap teeth are shortened by grinding from the front face the teeth must not be made too short when new.

Hand taps and all others that are backed out of holes tapped, are not given thread clearance. As standard taps do not admit of oversizes, a relieved thread tap would, if standard when new, fall below proper diameter when ground on the front faces in sharpening. A tap having relieved teeth will, when backed out of the thread it is cutting, allow the cuttings to wedge between thread and teeth, seriously injuring both work and tap. The backing of such a tap while in the work will frequently shale off the front face of the teeth.

Taps that pass through the work by driving continually forward, as with nut taps, are given relieved teeth; they cut freer and there is less friction between tap and thread, but should not be turned backward in the thread. The relief on these teeth is produced with uniformity and rapidity on machines specially designed for this purpose.

Hand taps are made in sets, three taps comprising what is known as a tap set. These are called the taper, plug and bottoming, as shown in Fig. 49. As manufactured by the Pratt & Whitney Company, the only difference between these taps is in the form of the point. They all have the same thread parallel at the root, and if passed entirely through the work will produce similar threads. The taper tap is parallel on the point for a distance equal to one-fourth the diameter of the tap. This point is made the diameter of the roots of the teeth, which is the correct size of the hole to be tapped in order to produce a full thread. The teeth at the shank end are parallel for a length equal to the diameter of the tap, and the balance of the teeth are tapered to the parallel portion at point. This gives a number of teeth between which the cutting duty in forming a full thread is divided.

The taper taps manufactured by some makers have teeth, in which the root diameter is small at the point, increasing on a uniform taper to the parallel portion near the shank end, and thus dividing the taper between the top and root of the teeth.

In the plug tap the first three teeth are tapered off, as shown, while in the bottoming tap the teeth extend full to the point. The fractional teeth at the point, which would be very apt to break, are ground away.

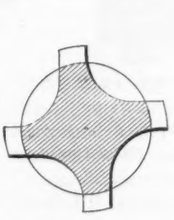


FIG. 55.

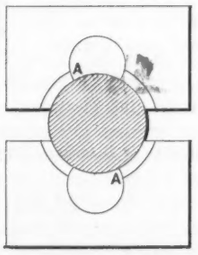


FIG. 59.

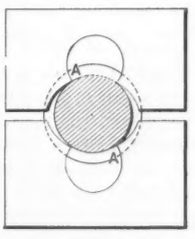


FIG. 60.

The taper tap is best suited to the starting of a thread, but unless the hole passes clear through, a complete thread will not be formed. The plug tap makes a full thread nearly to the bottom of a hole, which may be finished to the very bottom with the bottoming tap. The bottoming tap should be used, however, only to finish out the thread, as practically all the cutting is done by the four point teeth, which severely taxes their strength. When possible, it is best to drill the holes sufficiently deep to allow the plug tap to finish the required length of thread.

The plug tap is best suited to general work, but requires greater care in starting it axially true with the hole than the taper tap.

Machine taps are usually made of the plug pattern, but as they are held true to the work, no difficulty is experienced in starting them straight.

Standard taps are made from one to five one-thousandths of an inch oversize to allow for the wear on the top of the teeth. This means that a little less than the one-eighth is taken from the top of the teeth; the root diameter and sides of the teeth being correct, this does not affect the fit of the thread.

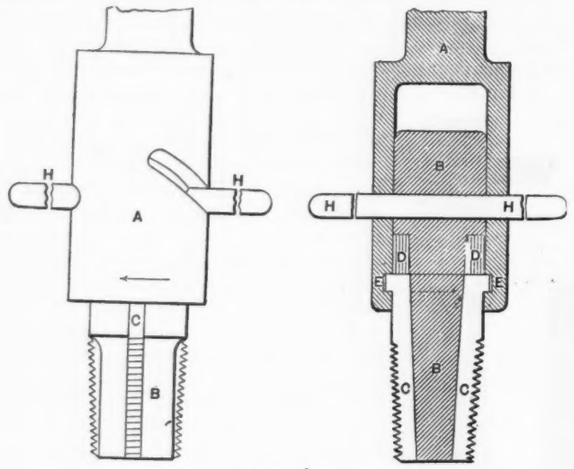


FIG. 56.

In Fig. 50 is shown a pulley tap used largely for tapping the holes for set screws in pulley hubs, a hole being drilled in the rim sufficiently large to allow the tap and shank to pass through. It is a regular plug tap with a long shank; the diameter of the shank is the same as the diameter of the tap. It may be had with any reasonable length of shank, and will be found a very convenient tool for tapping holes in inaccessible places.

The stay-bolt tap, as shown in Fig. 51, is a combined reamer and tap, used by boiler makers for reaming and tapping the holes for stay-bolts. The taps are made long, as the plates are often widely separated, and must be tapped together, as otherwise the stay-bolts will not enter the second plate without springing the plates a fraction of the pitch. These taps are sometimes made as long as five feet; they run from three-quarters to one and one-half inches in diameter.

A hob, or master tap, is one used for cutting the threads in dies. Fig. 52 shows a hob for cutting pipe dies.

The pipe tap shown in Fig. 53 has full teeth to the point, the standard pipe taper being three-quarters of an inch per foot. The following table gives the number of threads per inch on standard pipe threads:

FIG. 61

FIG. 62

FIG. 64

FIG. 63

FIG. 66

FIG. 65

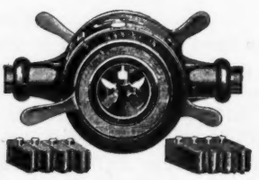


FIG. 67

TABLE OF PIPE THREADS.

Diameter of Pipe.	No. of Threads.	Diameter of Pipe.	No. of Threads.
⅛	27	1-1¼-1½-2	11½
¼-⅜	18	2½ to 10	8
½-¾	14		

A combination drill and pipe tap, shown in Fig. 54, is in quite general use. It is a valuable tool for drilling and tapping gas and water pipes under pressure.

A collapsing tap is one in which the teeth or chasers, after cutting the thread, are carried toward the center enough to allow them to clear the threads so that the tap can be removed without backing. This not only saves time, but the wear on the teeth incident to backing it out of the threaded hole. A form of collapsing tap is shown in Fig. 56; its action will be readily understood from the figure.

Taps are tempered hard and are consequently brittle. They give no warning before they break, therefore care and judgment must be exercised in their use. In using hand taps, a wrench which fits closely the square on the shank and having opposite handles of equal length, should be used. The pull on the handles should be uniform and equal. This produces a tortional strain in the tap, which, if working under proper conditions, it will safely resist. Any excess of pressure on one handle will produce a transverse strain which endangers the tap.

It frequently is necessary from the nature of the work to use a single handle. In such cases the operator must grasp the head of the tap and wrench with his left hand and balance the transverse moment of the pull at the end of the handle, allowing only the turning effort to be received by the tap.

In tapping full threads in tool steel great care must be exercised, especially if the stock is not thoroughly annealed. If much of this work is to be done two taps should be used, the first one through removing only a part of the stock, and the second finishing. In tapping double threads, two, or even three taps, should be used. This becomes necessary from the fact that with a double thread twice the amount of stock must be removed per revolution of the tap as with a single thread of the same depth. Taps for square threads should also be used in pairs, unless made extra long with a long tapered portion.

Fig. 57.

Fig. 58.

When a thread is to be tapped at right angles to the surface, do not depend on the taps following the drilled hole, but in starting test the angle by squaring to the shank of the tap. A tap started crooked must be squared up while the first two or three threads are being cut; an attempt to square it later may result disastrously to the tap, and will produce a threaded hole enlarged at the opening.

Dies.

Dies may be divided into two general classes; the first should include all dies requiring to be passed over the work several times in the production of a finished thread; the second, those that produce a finished thread at once over.

The first class, examples of which are shown in Figs. 57 and 58, consists of a stock in which cutting dies are held. These dies are capable of sufficient separation to enable them to be passed over the work upon which the thread is to be cut. By means of a set screw or threaded handle the dies may be closed an amount sufficient to make them cut a full thread.

In the manufacture of these dies they are threaded with a hob tap, the diameter of which is twice the depth of the thread greater than the diameter of the work the die is to be used upon. This

makes a die with teeth, the tops of which fit the work when the thread is started. This is shown in Fig. 59. It greatly facilitates the starting of a true thread. The conditions at the finishing of the thread are shown in Fig. 60, in which *A A* are the cutting edges. When the thread is started these edges have no clearance, but as the dies are forced toward the center an increasing clearance is formed. This is clearly shown in the figures.

The dies are chamfered off on the advancing side for two or three teeth, so that these teeth do the most of the cutting, those following simply sizing. If desired to cut a full thread close upon the shoulder the die is turned over.

Under the second class we consider first the screw plate, shown in Fig. 61. This is a thin plate of tempered steel, in which a number of holes of varying diameters, threaded with different pitches and provided with opposite notches to form cutting edges, have been produced. It is a primitive tool, suited only for work of small diameter, where correct threads are not required.

Dies of the second class are usually made adjustable to compensate for wear. In Fig. 62 is shown a form of die largely used for small sizes, one-sixteenth to one-quarter of an inch. It is given a spring temper at *C*, and is held in a wrought ring, not shown in the figure. A small set screw passing through the ring and engaging the notch shown in the die edge, serves to spring the die together, when through wear it becomes oversize.

Fig. 63 illustrates the Grant adjustable die, in which the four chasers are held in a cast iron collet surrounded by a wrought ring. The chasers are bevelled off on the outer ends, which engage with corresponding bevelled grooves in the ring. By forcing the ring down, the chasers are moved toward the center. The amount of adjustment in this die is one-thirty-second of an inch. The chasers are numbered, with corresponding numbers on the side of the grooves in which they belong. This prevents the possibility of putting together incorrectly when the chasers have been removed for grinding.

This die is sharpened by grinding back the front face of the chasers. They should be ground only a short distance back of the tooth root, so as not to interfere with the bearing in the collet.

In Fig. 64 is shown a solid machine or bolt die. It is made of the same form as the solid pipe die and may be used in either a hand or power holder. A die of this same general character, with adjustable chasers, is shown in Fig. 65.

The spring die shown in Fig. 66 is for use in a machine and where smooth, accurate threads are desired should be used in pairs, one for roughing and one for finishing. A clamp collar fitted over the end of the die prevents its spreading. This form of die can be sharpened by passing a thin emery wheel through the grooves.

There are numerous expanding dies made. They are used quite generally upon pipe work. In their use the die is open at the end of the thread and the work drawn out without backing the die. A form of pipe die of this class is shown in Fig. 67. The teeth of dies of this class may be relieved.

The advancing edge of the die chasers in all forms that produce a finished thread at one cut, is chamfered off for two or three teeth, which divides the cutting duty and facilitates starting the thread. The die should not be run bottom side up on the work, as in that case the first tooth does nearly all the cutting duty. Only in unusual cases is a workman justified in this procedure.

Oil should always be used liberally on the tap or die when cutting steel or wrought iron; a little oil on the tap when cutting cast iron or brass makes it run easier and does no injury to the thread or the tool. Sperm or lard oil is best for this purpose.

In threading steel or wrought iron by hand the tap or die should, after every two or three turns forward, be given a slight turn back. This facilitates the removing of the cuttings and allows the oil to find its way to the points of the teeth.

No matter how accurately a tap or die is cut the hardening process will distort it somewhat. If this distortion followed any fixed law, allowance could be made in the threading that would offset this variation, but as the distortion is variable, even when the conditions are the most uniform possible, it is difficult to make allowance for it. As a general thing the taps contract in length, thus decreasing the pitch, and expanding in diameter.

A die of standard diameter must not be used to thread stock that is one-thirty-second of an inch oversize, as the strain on the die parts is too great.

The practice of rolling iron one-thirty-second of an inch oversize is to be condemned as the cause of mistakes, lack of interchangeability and general confusion, at the same time having no advantages. It is not practical to roll ordinary bolt stock to exact sizes, yet the variation need not be great and can be taken care of by the standard dies.

To determine the diameter of hole required to give a full thread, caliper the root diameter of the tap, the point of the taper tap, or consult a table of tap drills. The number of threads per inch is always plainly stamped on the tap or die. Remember that U. S. S. for five-eighths of an inch is 11, not 10, and for half of an inch is 13, not 12 threads per inch. Always keep die and tap threads sharp by grinding from the front faces of the teeth. When dull they jam rather than cut the stock and require excessive power to operate them.

* * *

HORSE-POWER NOVELTIES.

In the above heading we do not refer to the mechanical horse-power represented by doing 33,000 foot-pounds of work in a minute, but rather to the original and true meaning of the term before James Watt borrowed it for steam-engineering purposes.

But we need not go back to the time of James Watt to find genuine examples of horse-power. It is still used for agricultural and other purposes where horse flesh is cheaper or more common than iron, steel and coal, and sometimes the means adopted for converting horse-power from the "noble animal" himself into mechanical horse-power are decidedly novel. Such an instance is described in a recent issue of "The Railway and Engineering Review." In North Chicago there was a draw-bridge that was designed to be operated by hand and that was tended by a man who didn't like to work any harder than most other people do; but, unlike many other people, he had brains enough to get out of the trouble and earn for himself a place of comparative ease and comfort. He connected a treadmill with the bridge gearing and enclosed it within a stable. The horse remained standing upon the treadmill during the day ready for instant service, but for his comfort the floor of the mill was inclined only about 1 inch in 2 feet. To overcome this disadvantage a harness was arranged for the horse to brace against when operating the mill. This seems like a sensible plan, as it enabled the horse to work under more natural conditions than in the ordinary mill, and he could also conveniently take a nap between the acts. To prevent accident to the horse by falling when the mill was in motion, a strong girth was used, attached to the sides of the stall.

Not the least novel part of the system was the provision for operating the bridge at night when the horse was not there, and the man was not over anxious to be. It was arranged so that a 3,000-pound weight could be raised 26 feet high through the efforts of the horse, and the potential energy thus stored was sufficient to open the draw three times while the weight was descending to the limit of its travel.

For downright ingeniuity and all-round utility, however, a country editor up on the Canadian border had a horse-power appliance that easily bore off the honors. He evidently reasoned that a horse and carriage would be a luxury for his family and that when not thus employed the horse might as well be worked in at the office.

His printing press was on the third floor. In the basement he mounted a large circular platform on a central shaft that was inclined somewhat from the vertical. This shaft was geared with a horizontal pulley through a pair of old-fashioned, bevel cog-wheels, and a vertical belt ran from the pulley up to the press. On publication day the horse was led up onto the platform and hitched, a brake having previously been set up to hold the platform stationary. When the pressman was ready he released the brake. The horse felt himself going backwards, owing to the inclination of the platform, and was obliged to commence walking in order to keep his equilibrium. The press was stopped by applying the brake until the machine went so hard that the horse had to stop.

Like the first apparatus described, this one seemed well adapted to its purpose. One leap year the weeks spaced around so that there should have been fifty-three issues of this enterprising publication; but the editor announced that his subscribers were entitled to only fifty-two numbers, and went off on a vacation instead of getting out the fifty-third. It was a one-horse paper in a one-horse town, and nothing could be more fitting than that it should have a one-horse horse-power.

SEWING MACHINERY.—2.

THE MAIN FEATURES OF THE CHAIN-STITCH SYSTEM AS FOUND IN THREE OF THE BEST KNOWN MACHINES.

F. W. Brady.

The metals used in the construction of sewing machines are few in number, most of the parts being of steel or cast iron. Even brass is seldom used, and is, in fact, almost totally ignored. In a manufacturing machine, all of the reciprocating parts are of steel, the needle bars being hardened. The cast iron used is of the finest white quality, with a texture as fine as silk, and free from blow holes and other imperfections.

The modes of fastening levers, cams or other parts on the shafts and rods involve set-screws and pins, the screws being used "on the quarter," where adjustment may be necessary.

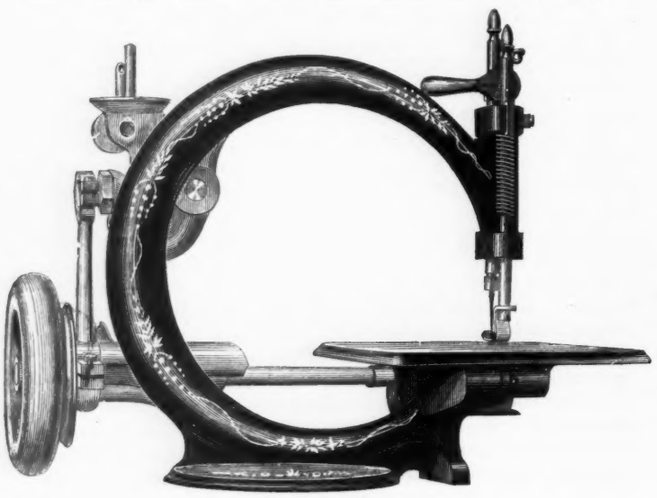


FIG. 1.

Keys and feathers are not practical for such small work in an average machine, 7-16 inch being the largest shaft, the majority being much smaller.

The hardened pieces consist partly of all parts coming in direct contact with the thread, which are polished to a very high degree of slipperiness. It is customary to run steel on steel, contrary to the usual rule in heavier machinery. Here the parts are hardened and ground to a degree that prevents cutting, although there is sufficient power required of these machines to cause cutting, for the writer has tried steel pins in steel eyed-rods, unhardened, and they cut every time, and they even cut if slightly hardened. If you desire to ruin a machine, use emery in finishing the parts and neglect the thorough cleaning afterwards.

The Wilcox & Gibbs Machine.

The chain stitch machine, being the simplest, will be discussed first. The Willcox & Gibbs machine was originated by Mr. Gibbs, whose brain was greater than his mechanical education—a possible excuse for his producing a new seam at the time. A model hook, constructed of wood (which material, by the way, was and is the sewing machine inventor's great assistant), was the secret of Mr. Gibbs' machine. Mr. Gibbs became associated with Mr. Willcox, a man of considerable machine experience at that time, and between the two was created a marketable sewing mechanism. At this time the shuttle machine was quite in disfavor, owing to the clumsiness of the moving parts and its complexity.

This machine entered the field the acme of simplicity and easy running, this latter being of vital importance, for the machines were then intended exclusively for housewives. The stitch was new and subject to great opposition; but it has worked its way into favor, and is universally used in many branches of factory and home sewing.

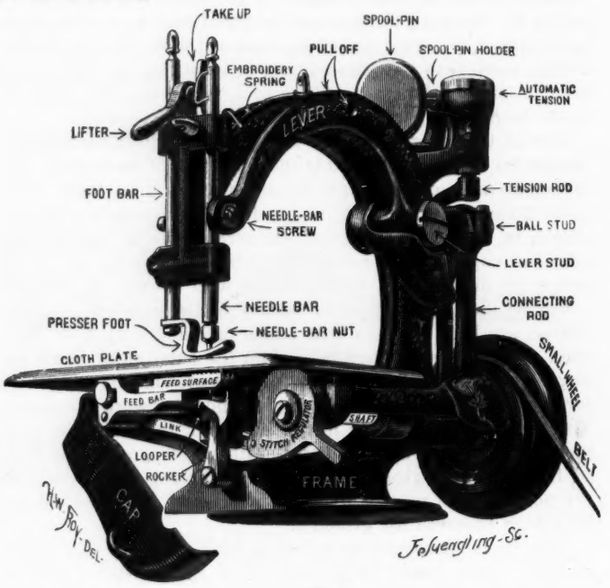


FIG. 2.

One of the early (1870) machines is shown, Fig. 1, the "frame fitting the name" in almost every detail of the letter G. Just whether this was intentional is not known, but the form was so satisfactory that it has since been retained in its essential details, as appears in Fig. 2, which shows the 1897 machine.

The rotary hook, explained in the preceding article, is shown in detail in Figs. 3 to 9, inclusive, exhibiting an interesting means of taking and throwing off a loop. At first thought it would seem that the thread would become wound around the driving spindle, but such is not the case. The needle, beginning to ascend, forms the loop (Fig. 3); the hook enters (Fig. 4); a further rotation draws the thread through the needle eye, and spreads out the loop on the broad face of *L* (Fig. 5). The loop twists, the round corner at the top of the hook throwing thread 2 to the front, allowing thread 1 to go to disc *K* (Fig. 6). With this loop wide open the hook enters the second loop (Fig. 7). The remaining figures, 8 and 9, show the casting-off and new loop forming. When one considers the duties of this little piece of steel, it is surprising that the above operations can be repeated over two

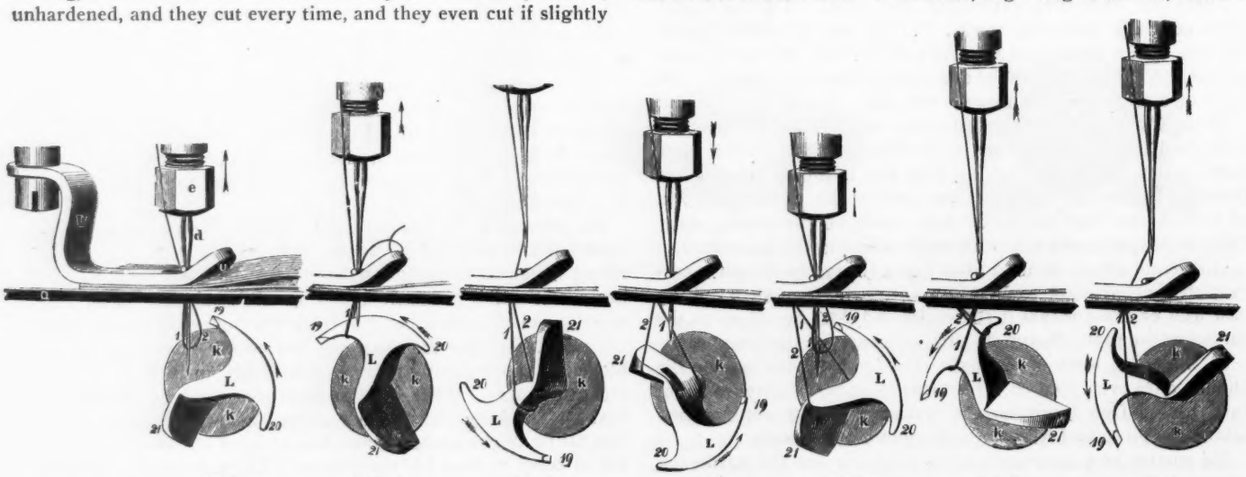


FIG. 3 FIG. 4. FIG. 5. FIG. 6. FIG. 7. FIG. 8. FIG. 9.

thousand times a minute, without "misses" or failures in any way.

The tightening of the stitch is accomplished partly by the hook drawing the previous loop, as at Fig. 8, and partly by the upward motion of the needle against the tension (Fig. 2). The tension for regulating this is easily made automatic. In this stitch, there being no balancing of threads in the fabric, a tension once found correct will continue so for finer or coarser fabrics if the following points are noted: First, the needle used must correspond with the thread, coarse needle having a coarse eye being used with coarse thread; this gives a constant friction in the needle. Second, the

FIG. 10.

length of stitch must be regulated to correspond with the fabric. The tension in Fig. 2 is a spring actuated disc, which is raised automatically for the passage of the thread, but which closes suddenly with the down movement of the tension-rod, and in reality locks the thread between the discs. It is apparent that a slight difference in the diameter of thread would not affect the tension spring, except to tighten it for the coarser thread, which, of course, is an advantage.

A ball stud is used to connect the needle lever with its driving rod. Often in sewing machine construction the ball pitman is used, and is always satisfactory, owing, no doubt, to careful making. It is generally a good substitute for an extensive system of links, for the purpose of "turning a corner." Both balls and sockets being made with special tools, their cost is small.

A good test of accuracy in a machine may be made by testing the feeding parts. It is absolutely necessary to have the feeder movement perpendicular to the lines of shafting; and if it is not it is very noticeable, as the cloth will not feed straight. Many of these machines are used in factories, where strips of considerable length are stitched without hand guiding. Here the piece is started and left to care for itself, the operator attending to other machines doing similar work, the seam joining accurately on endless pieces.

The machine (Fig. 2) has a prominent peculiarity in the overhanging needle lever, which principle has been adhered to, in spite of the almost general tendency to provide a shaft for this duty, suspended in the arm casting.

As all the W. & G. machines are small and adapted for the lighter classes of work, this arrangement is probably as good as any; but it is certain that it could not endure the work of the heavier shuttle machines at the same speed. While other builders have enclosed all the running parts, the parts of the chain-stitch machines have remained exposed, small boards providing protection from oil in a few cases. The whole machine seems to be in the same simple state in which it was produced in the beginning.

The Singer Machine.

Continuing to the Singer machine, it might be well to state here that the Singer Company make the widest line of sewing machinery of any concern in the world. With unlimited facilities, we expect to find their output of the very highest order. They have been building chain-stitch machines for eight years, their latest production being shown in Fig. 10. The rotary hook is used to form the loop, and an automatic or plain tension to

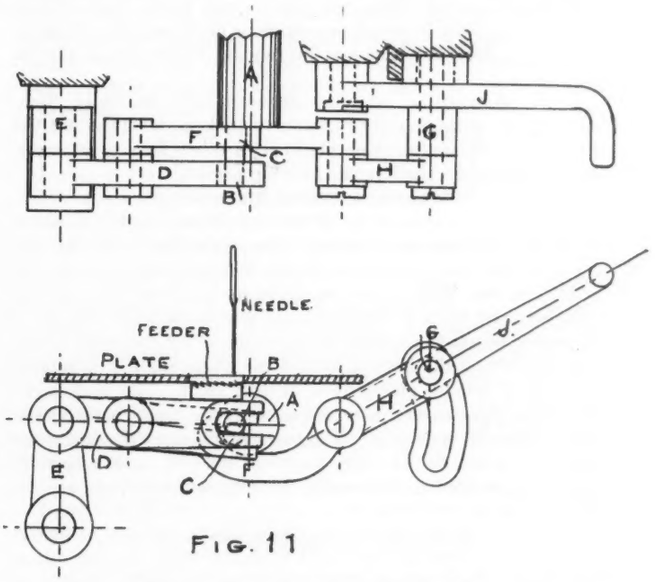


FIG. 11

regulate the seam, the "pull-off" at the side taking the thread from the spool. At the top is an oscillating shaft to move the needle bar, the head being entirely enclosed.

A rather compact feeding movement is used in the Singer machine, a view of which is shown (Fig. 11). It involves quite a few joints and links, but with jigs and tools is made accurate

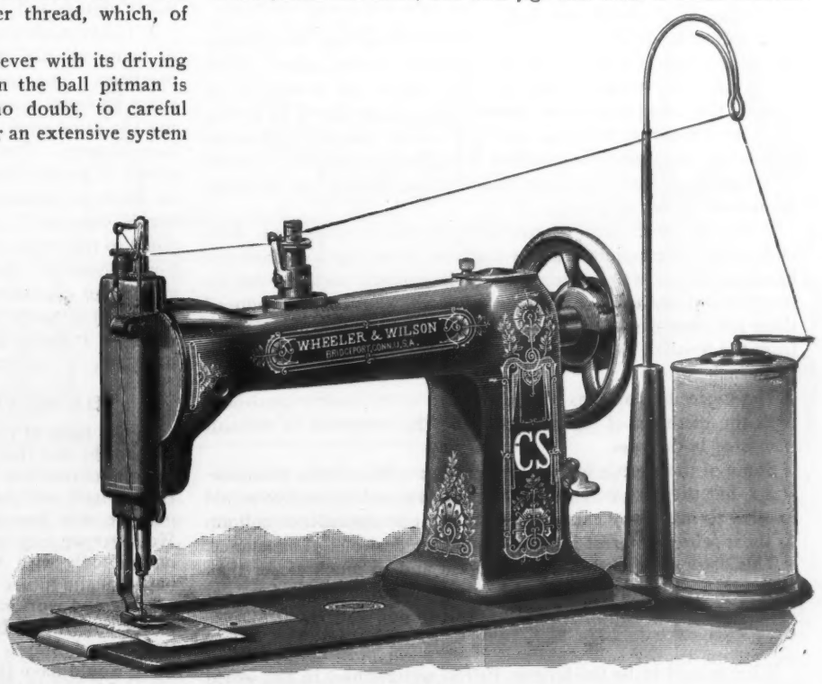


FIG. 12.

and cheap. *A* is the rotary hook shaft, on which are two eccentric pins, *B* and *C*, turned on the quarter. The feeder is below the fabric on the plate, and is operated in the same plane by the rotation of pin *B* in the slot of lever *D*, which is suspended on rocker *E*. This gives two of the four required movements. The actual feeding is accomplished by the up and down movement

of pin *C* in the slot of lever *F*, which is carried by lever *D*, its other end being suspended from *G* by a link *H*. This really forms a toggle joint. Behind *H* is pivoted an adjusting lever *c*, which is guided in the circumferential slot. The motion of the toggle (*G* being fixed) causes a lateral motion of the feeder by the rocking of *E* on its pin. The amount of this movement depends on the position of *G*. The nearer the latter is to the straight line of centers, the smaller the feed or stitch. It makes a very compact arrangement and an easy running motion, a great advantage being that it is positive in all directions, not relying on springs to assist it in any manner.

The links are cast of fine iron, and are very light. The cut does not show the actual sizes, proportions or positions, the adjusting lever being under the plate and entirely out of the way, as the cut shows.

The ornamentation is quite elaborate and the finish high, making the machine a pretty thing to look at, which is not the aim of the average machine designer in other lines of business, the days of brass cylinders, etc., having passed.

Wheeler & Wilson Machine.

Fig. 12 gives a view of the Wheeler & Wilson machine, which resembles their standard output. The main shaft is at the top, and a double link connection driving a rotary shaft is under the bed. The two links are set to cause no dead centers. As the machines run toward the front, and the hook oppositely, it is necessary to get the change in direction under the bed; so, instead of driving the hook direct on the under shaft, it is rotated by a short spindle gear driven by this shaft. The feed is accomplished by two cam movements, with the usual characteristic of the W. & W. machines. The parts which carry the feeder are bars, which extend the entire length of the bed, back and front, and are suspended at their ends. This gives a very long and accurate bearing for the feeder.

This machine will stitch very heavy goods, or piles of lighter weight. The construction is much heavier than the two others described. They manufacture a still heavier style, capable of sewing twelve thicknesses of burlap.

All of these machines are fitted for certain classes of light work, having particular value in the manufacture of hats, caps, laces, hosiery, etc., or in the cheaper grades on heavier work. Their simplicity and speed are greatly in their favor, but the writer must admit his preference for the lock-stitch in anything save such duty as is mentioned above.

To the average eye, many little eyes and springs for guiding the thread appear useless, and the question is often asked "Why not guide the thread straight?" The action of sewing is so delicate that often times a satisfactory seam is produced by giving the thread a corner to turn, which, in reality, creates a difference in tension, not enough to measure, but enough to affect the work. It is apparent from this how much actual sewing can be done from a set of drawings.

While the draftsman is invaluable in this business, his field ends at the main points of a new machine, he taking it up from the hands of the experimenter. In the chain-stitch machine the intricate combinations are few, but when the shuttle is introduced there are often parts which are impossible to put on paper, except from the finished piece itself. Then the work is to the hundredth of an inch.

The succeeding articles will be devoted to the shuttle machines, with the methods of manufacture, and the evolution of difficult pieces of both types.

Some of the shuttle movements require a little study to understand, but they are well worth the exertion, and the writer would be glad to make any explanations in the correspondence column to those whose interest is aroused and are desirous of assistance.

This class of work being so different and so much closer than the average, the study of it will broaden the mind of any one, except of those who know it all; but they do not read MACHINERY.

* * *

What is said to be the largest Pelton water-wheel in the world was recently installed in Alaska to drive an air-compressor plant for mining purposes. The compressor is arranged to be driven by steam, but a Pelton wheel is placed on the compressor shaft in place of the usual fly-wheel. The water-wheel is 22 feet in diameter, weighs 25 tons, and will, when running under a head of 480 feet at its normal speed of 75 revolutions per minute, develop 500 horse-power.

HORSE-POWER OF A WATERFALL.*

A horse-power is ordinarily stated to be 33,000 pounds lifted 1 foot high in a minute, and, as the statement of a formula, that will do well enough. But to become acquainted with the nature of the thing defined more thought and words are necessary. The term had its origin with James Watt, the inventor of the steam engine, properly so called. He and his partner, Boulton, wanted a measure of the power of their engines to be offered for sale, and, having noted that on a straight pull a stout horse, for a short space of time, could lift a weight of 550 pounds, say out of a well, at a speed of 1 foot high in a second, they called that a horse-power. This is a product of weight into speed or rate of motion, speed being itself composed of linear length and the time taken to pass over it. So long as the product of feet and of pounds raised per second remains the same the horse-power is the same, for we have just seen that 550 foot-pounds per second is the same as 33,000 foot-pounds in sixty seconds, or in a minute; 33,000 foot-pounds in sixty seconds being 550 foot-pounds in one second. Similarly 1,100 pounds 1 foot high in two seconds, or 550 pounds 2 feet high in two seconds; or 33,000 pounds 3 feet high in three minutes, are all equal to one horse-power, as arbitrarily established to be equal to the power of a horse by James Watt. Now, how does a waterfall represent horse's power? To understand this it is but necessary to recur to a consideration of the origin of the term horse-power, as above described—to the stout horse pulling a dead weight at a certain speed up out of a well. If, instead of the powers of contraction of the horse's muscles, we were to substitute to raise our dead weight out of its well a live weight falling into another well, this live weight being sufficiently heavy and so connected that it will cause the dead weight to come up out of its well as fast as the horse originally brought it up, the apparatus would still be exercising 1 horse-power. Now substitute the weight of a stream of water for what I have called a live weight and we have a stream of water exercising continuous horse's power. Water weighs about 62½ pounds per cubic foot, and theoretically, therefore, a cubic foot of water falling through a space of 1 foot in one second should raise 62½ pounds of dead weight 1 foot high in a second; or, a horse-power, being 550 foot-pounds per second, is about 8.8 cubic feet of water per second on 1 foot fall. Practically, it is generally nearly 12 such cubic feet per second on 1 foot fall, owing to unavoidable imperfections in water motors and in water connections.

If I have made myself clear, you can see at once the importance of using all the attainable fall in the development of a water privilege. The space the water descends is a measure of the space an equal weight could theoretically be made to ascend during the same time; in other words, it is a direct measure of the horse-power. The same water on a 20-foot fall has twice the power it would have on a 10-foot fall. And, as power is worth so much per annum, a gain of fall for power that is in constant use is warranted at an expenditure whose interest charges are equal to the value of the horse-power gained. To gain a 12-hour horse-power or a 24-hour horse-power, worth, say, $20 or $40 per annum, an expenditure of nigh $500 or $1,000 in raising the dam, gaining fall in the head race or in the tail race, or for the purchase of a better wheel and its successors, or their gearing, is justifiable.

* * *

THE FUTURE OF THE STEEL TRADE.

In the light of recent experience it would be folly to shut our eyes to the fact that America is now a factor to be reckoned with in competition for iron and steel contracts. The future of the British iron and steel trade will depend very much upon how we may be able henceforth to hold our own against this rivalry. However we may be harassed in other quarters of the world, it is undoubtedly with American enterprise and skill that the serious battle of the future will have to be fought. And the sooner employers and workmen alike grasp the situation the better it will be for our trade. It was expected that when the improvement in the United States iron trade set in that an increased demand there would have the effect of diminishing the export. It cannot be said as yet to have resulted in this way. It would appear that the output capacity of the American works is greater than the home demand, and there is always a large surplus for export. United States agents have been actively, and often successfully, engaged here in pushing the sale of American iron and steel tubes for various purposes.—"The [English] Trade Journal's Review."

* From an address before the American Paper and Pulp Association, by Clemens Hershel.

WHAT MECHANICS THINK.

A DEPARTMENT FOR THE EXPRESSION OF PRACTICAL IDEAS OF INTEREST, TECHNICAL OR OTHERWISE.

Write on one side of the paper only, and when sketches are necessary, send them. No matter how rough the sketches may be, we will see that they are properly reproduced.

TURNING BALLS.

In the article in the February number of MACHINERY, by E. H. T., on turning a governor ball, he says there was "no time to make gauges." A very good gauge for spheres can be picked up in nearly every machine shop whenever wanted, and is simply a hole in a piece of metal not too large nor too small—say, for an 8-inch ball any hole from 2 to 4 inches in diameter;—a bushing, a

Fig. 1.

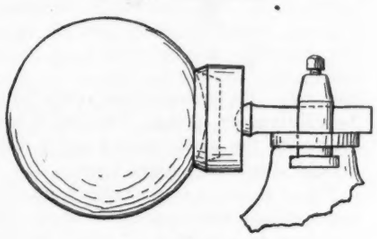


Fig. 2.

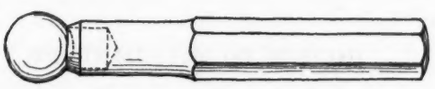


Fig. 3.

collar or any of the numerous pieces that holes are found in in a machine shop will do. The edge of the hole, if faced off square, will touch all around on any portion of a sphere, as shown in Fig. 1.

A scraping tool, Fig. 2, can be made on this idea from a piece of tool steel beveled to an edge and hardened. After the ball is rough turned such a tool can be used to scrape it smooth and true. It cannot be worked around very close to the centers and need not be where there are two sets of centers, as in E. H. T.'s case.

I have turned and seen turned hundreds of small brass balls about 5/8 inch in diameter with a simple tool like Fig. 3. The hole was deep enough for repeated grindings and the tool long enough to be held firmly in the hand while it rolled over the work on a T-rest.

Springfield, Mass. JIM DUNLAP.

INKING OVER ERASURES.

E. W. Ashenden, Minneapolis, writes us: I enclose a piece of tracing cloth which I think would be of interest, as you will notice the lines have been erased in two places, and one of them polished over again, which makes a good surface to ink on and does not catch the dirt as the unpolished part would. The polish is put on with French chalk or soapstone and then rubbed down with a good clean white blotter. It is best to split the blotter to insure its being clean, and to have two grades of chalk, one hard and one soft, the latter to be used first, then the hard.

ABOUT ANCHOR BOLTS.

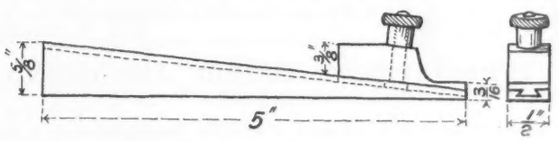
In the January issue F. E. G. has a sketch of an anchor bolt which is one much used in mining except where extra heavy strains are to be put on it, when the hole is drilled straight to within four or five inches of the bottom and then enlarged by using the same diameter drill, but making it long-cornered and having the outside corner very sharp, so it will gradually enlarge. A bolt put in this way will break before it will pull out.

Douglas, Alaska. B.

ANOTHER WIDTH GAUGE.

I give a description of a width gauge or gib gauge which I think is more convenient than the one described in the February number. Below is a rough sketch.

One made to these dimensions will measure from 3-16 inch



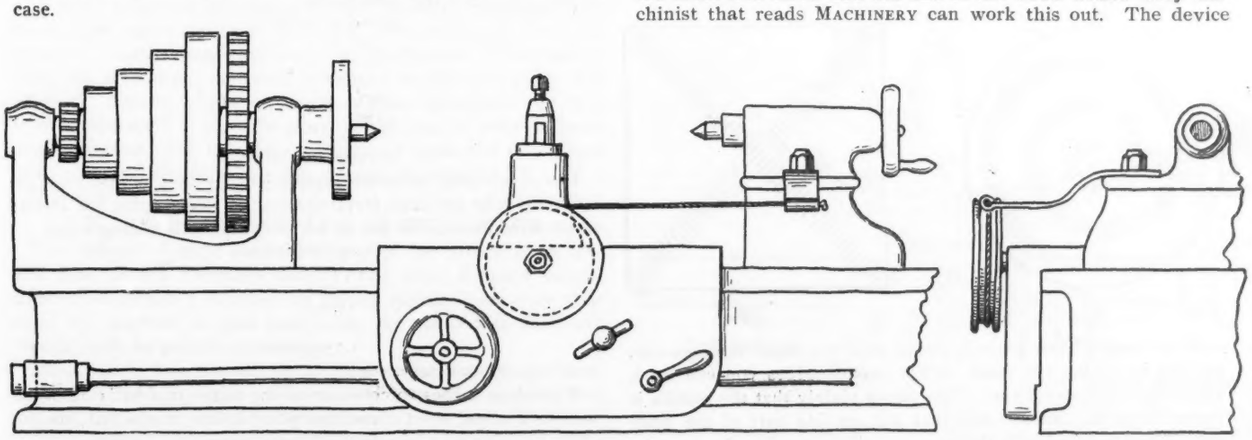
to 1 inch and is especially convenient for measuring gibs, as after getting the measure it can be set on the platen and the tool can be set to it.

It is also handy to set by micrometer for a small inside gauge.

Dover, N. H. J. H. SMITH.

TAPER-TURNING DEVICE.

The device shown in the accompanying sketch can be used for boring or turning tapers to good advantage where the lathe is not fitted with a taper-turning attachment. Take off the handle of the cross-feed screw and put a hard-wood wheel in its place, grooved out to receive a stout cord or small cable. Fasten one end of the cord to the tail stock and use the longitudinal feed. The taper will of course depend upon the number of threads on the cross-feed screw and the size of the wood wheel. Any machinist that reads MACHINERY can work this out. The device



has been successfully used to bore taper-jets for ejectors used to exhaust air in vacuum brakes. I have also used it on other work with good results. G. W. GLEASON.

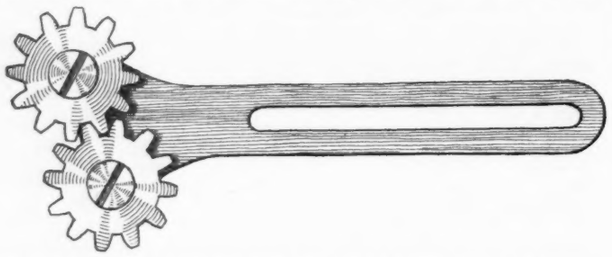
Bayonne, N. J.

CUTTING RIGHT-HAND SPIRALS.

Any one who has had much experience in spiral gear cutting must have noticed how awkward it is sometimes to rig up the lead wanted. Sometimes the gears called for are all small ones, or perhaps the ones which should mesh are smaller than those which should not. Of course there are different ways by which you can get over this in some cases, but there are other times when it comes awkward any way, and I have seen fellows take considerable time trying to rig up their machines and then give it up in despair.

I have noticed, however, that when the gears to be cut are left-hand, there is never any bother about it, as the little revers-

ing gear makes up the difference and comes in to connect the other gears where they would not be large enough to come together without the use of the intermediate gear. So I began to wonder if something could not be devised for use when cutting right-hand spirals, and finally hit upon the plan of using two intermediate gears, which of course give the same direction of motion as if none were used. I send you a sketch of the rig, the



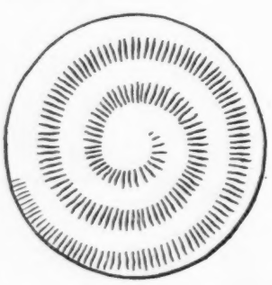
two pinions being on a slotted arm which can thus be clamped in any position necessary to bring the pinions in gear with the other wheels. I made a rough one first, but when I showed it to my foreman he had me make one for each of the four machines then in use. Perhaps the idea may help someone else.

Providence, R. I. GEO. H. NORRIS.

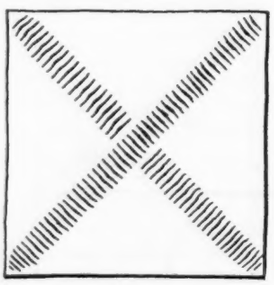
STRAIGHTENING SQUARE AND ROUND PLATES.

Straightening No. 10 steel plates for templates with a common hammer seems to be a job requiring skill, when at times you watch some machinists who are trying to get a bulge out of a plate, when really they are getting it deeper. I have often enquired of good sheet-iron workers how they hammered their plates straight, but they could never answer. They thought it was a matter of practice only.

The eye has to detect the high and low places in a plate. There should be a good disc to hammer the plate on, which should be faced a little higher at the center than around the outside. The plate can then be turned around easily and tried. The hammering should always be by light blows, which should sound solid on the plate. When the scale is off the plate is easier to straighten. The low places can be hammered out by a few well-directed blows, the hammering being done on the low or hollowing side of the plate.



A



B

Sometimes a loose place is found after the bulge is taken out, so that by taking the plate on the outside edges you can work the middle like an oil can. This shows plainly that the middle is looser than the outside and that the outside part of the plate should be stretched with the hammer. This can best be done by following the path of a spiral until the loose place is taken out, as at A.

Any bulge in a square plate can be taken out in the same way, but the loose part of a square plate is likely to come different from the loose part of a round plate. Sometimes with a square plate two opposite corners will come high and the other two corners low. Hammering on a diagonal from one low edge to the other, as shown at B, will straighten the plate.

All stamping on plates should be done before straightening.

San Francisco, Cal. F. E. G.

HANDY CHUCKS FOR LIGHT WORK.

It very often happens that a job comes to the machinist in the shape of a thin disc or ring of brass or other metal to be operated upon. The first thought that comes to him is "How shall I hold the thing?" In the September issue of MACHINERY I gave some pointers on how to utilize pipe reducers, making of them very efficient cup chucks. Now I will give some information of contracting and expanding wood chucks. I expect this information will be old to many of the readers of MACHINERY, but there are always young men that are very thankful for these old commonplace ideas.

The pipe reducer mentioned can be utilized to hold the wooden piece of which the chucks are made. Fig. 1 shows a ring chuck. To make it, place a piece of maple or beech wood in the chuck and turn it to the required size. Bore a hole in the end and turn it out to the size of the work you wish to hold to the depth of the

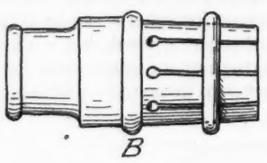


Fig. 1.

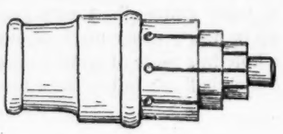


Fig. 2.

saw-cuts. By having a hole at the bottom of each slit there will be a little more spring. The ring *B* is simply a malleable harness ring with the inside turned out a little tapering and the chuck should also have a slight taper.

Fig. 2 shows a similar chuck, except that it has steps on the outer surface and a taper hole in the end, into which a taper plug is driven to expand it. I think the illustrations are sufficiently clear to enable any workman to understand the construction of these handy tools.

Angelica, N. Y. F. H. JACKSON.

INCHES TO MILLIMETERS.

In reducing decimals of inches to metric denominations it is convenient to have a short way which will give the same result as though the regular multiplication process were resorted to. I have recently had to put a lot of "half gauges" into millimeters, in connection with the performance of a wire-nail machine, and as half-gauges, such as 15½, 9½, etc., are not down in any of the "pocket books" which I have seen, there was nothing for it but the pencil-stump. I assumed that on a sliding scale No. 15½ would be half way between No. 15 and No. 16, and that would give me for "B. W. G." $(0.72 + 0.065) \div 2 = 0.0685$ inch. To multiply this by 25.4 to reduce to millimeters involves, by ordinary methods, this operation:

0.068 5 inches.
25.4

274 0
3425
1370

1.73990 millimeters

The result may be more rapidly got by first multiplying the inches by four and then dividing them by four, setting the second result down one to the left of the first, and then adding thus:

0.0685 inches.

2740
17125

1.73990 mm.

pointing off as before.

To reduce inches to centimeters the same process is observed, but the decimal point comes one place further to the left; thus:

1.625 inches.

6 500
406 25

.4127 50 cm.

In reducing pounds avoirdupois to kilograms I add a cipher mentally and divide by two and by eleven; thus:

18000 lbs. av.
9000
8181. kg

ROBERT GRIMSHAW.

SMOKE PREVENTION.

A few years ago there was exploited in the West by different people and under various names, a contrivance which was called a smoke burner for boiler furnaces. The apparatus consisted of a power driven fan, so connected that it took its suction from the britching or smoke flue, and discharged under the fire into the closed ash pit, so that the supporter of combustion could come

only through the fan. The idea of this scheme, as given by the promoters, was this: The smoke and "unconsumed gases" which had escaped owing to uncompleted combustion, were carried back and passed through the fire, where the smoke was "burned," as well as any other combustible in the flue gases. These people, however, seemed to realize that a little fresh air added to the mixture was a good thing. Consequently an opening for air, controlled by a damper, was provided in the fan suction pipe. This added cold and fresh air was supposed to become heated by contact with the hot gases of the flue, and hence enter the ash pit at an increased temperature. As the addition of new air would increase the volume, and there would be a surplus that must be got rid of, the smoke flue with which the fan was connected was also provided with a direct passage to the chimney.

Now this scheme when working in all of its beauty was supposed to operate in this fashion: The smoke and "unconsumed gases" were returned through the fire, where, of course, owing to the great heat, the smoke and gases were burned. Then the new air taken in would mix with the smoke and hot gas and abstract the heat therefrom to be returned to the fire. After the gases had been sufficiently manipulated by this endless chain process they were allowed to escape by means of the outlet passage to the chimney. A large fuel saving was one of the advantages claimed.

There were quite a large number of these outfits erected, and some for a time gave satisfaction. The writer, in company with one of the promoters, viewed one or two of these plants, where the owners expressed satisfaction with the device, and said that it was saving money for them. In answer to the inquiry by the writer, how it was that he could do what was considered contrary to the known laws of chemistry, he said that he could not explain it himself, and said "but there it is, ask the proprietor yourself; don't believe me."

Upon a little investigation, however, the reason for this wonderful achievement was apparent. The fresh air inlet and the final gas outlet were controlled by adjustable dampers, which were supposed to be manipulated till the proper conditions were established. While the representative of the promoter was on the ground—which was usually until the outfit was paid for—he made and maintained the adjustment of these dampers, and by allowing the fan to draw fresh air, rather than smoke, the fire was maintained in fair condition. Under these conditions then the apparatus became simply a forced draft plant. This allowed of a cheaper grade of fuel being burned, usually screenings, and hence there was a saving in fuel cost. Also, as forced draft will produce a combustion with much less smoke than with chimney draft, the scheme got the credit of being a smoke preventer. But when the apparatus was left to the regular attendants and they tried to operate it in all of its glory, failure was the result. Some more fortunate ones, however, changed the apparatus to a forced draft pure and simple, with a fair amount of success.

Chicago, Ill. A. BEMENT.

FILING SOFT METALS—A FILE RACK.

Mr. Editor: I have read with interest the article upon files and filing in the February number, but while I notice several allusions to practice in filing the harder metals, I see very little upon that bugbear of most machinists, the use of files upon soft metals, such as copper and lead.

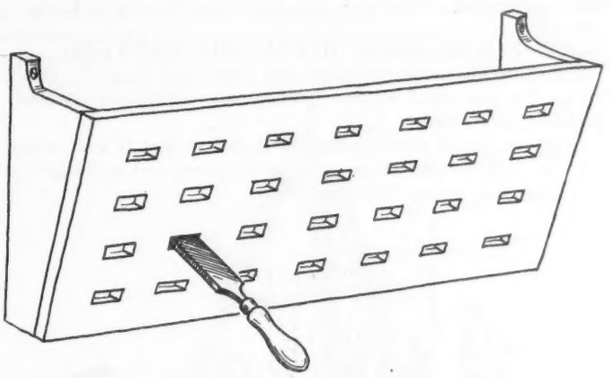
We all know how the soft metals clog up files, and how general is the fear that a good file will be spoiled or so filled as to be very difficult to clean if used for that purpose.

I have talked with many men about it, and have tried to find a remedy somewhere in print, but the almost universal belief seems to be that the best thing to do is to use an old file that has little value for other work. However, a long time ago, I found a remedy which seems very obvious to me: Cover the file with all the oil it will carry, and keep it covered, and the metal will clog it very little, if any more than will steel. I would never hesitate to use any file at hand to file the worst metals I know of—and I've tried almost all—feeling sure that a file card would remove the filings quite as thoroughly as steel filings would be removed.

I also send a sketch of a file rack that I devised some years ago, and as it has been favorably commented upon so often by those who have seen it, perhaps it will be of use to your readers.

No description is necessary further than to say it is made of a board fastened to the wall, and having the holes cut far enough apart so as to allow files to be put in or taken out with convenience. Once I thought of having a pattern and making several castings, but the files stick better when the rack is made of wood. The rack should incline somewhat as shown, though some may prefer to put it up parallel with the wall.

I painted two or three vertical lines on mine and kept the various kinds of files assorted and separated by the lines.



If the rack is put up as high as possible, yet with the upper row of files easily within reach, the whole assortment may be seen at once and chosen from, and they are always out of the way.

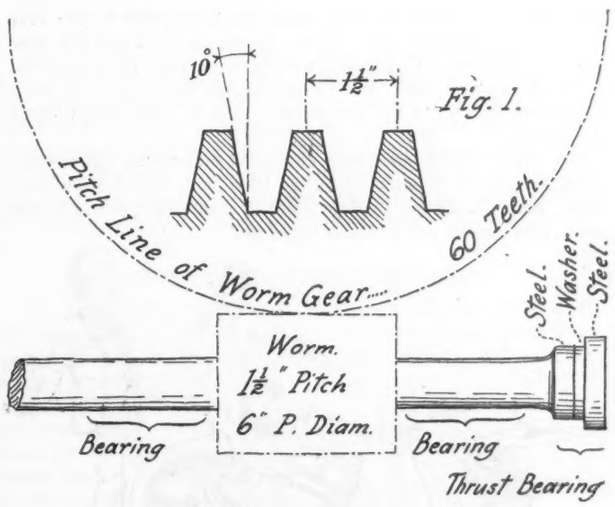
Objection may be made that the plan offers too good opportunity for borowers; then put on a lid and lock and key.

Rochester, N. Y. FREDERICK M. BUSH.

MORE WORM-GEAR DATA—BALL BEARINGS.

Details and results of a worm-gear hoist, submitted by Mr. C. A. Macy, superintendent of the Machinery Construction Company, Rochester, N. Y., as a contribution to the worm-gear discussion, are given in the following:

Beginning with the construction shown in Fig. 1, the desired load could not be lifted by several hundred pounds, and the worm was reduced from 6 inches to 3½ inches pitch diameter, which increased the efficiency fully 30 per cent., pitch and other conditions remaining the same.



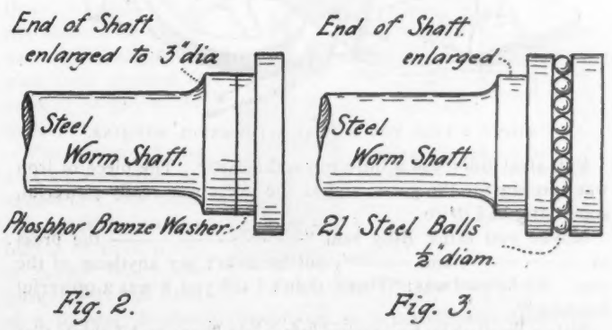


Fig. 2. Fig. 3.

Fig. 2 gave the best results of several combinations of metals that were tried as a thrust bearing for the worm shaft, and in connection with the smaller worm, gave the hoist its greatest

efficiency until Fig. 2 was replaced by a ball bearing (Fig. 3), which still further increased the lifting capacity of the machine by 75 per cent. of the best previous results.

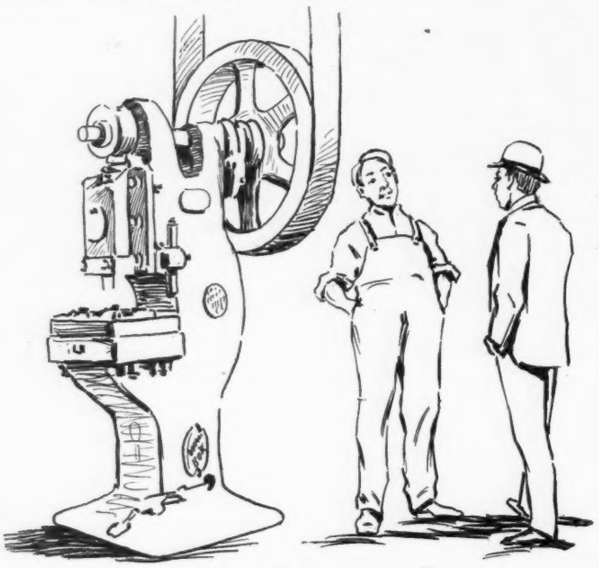
The hoist was electrically driven and provided with both ammeter and volt-meter, registering the same when each of the tests were made. A. L. G.

* * *

THE MAN WHO NEVER GOT RATTLED.

Billy Charling some years ago was owner and boss of a small shop. He was noted for two things—first, enthusiasm; second, he never got rattled.

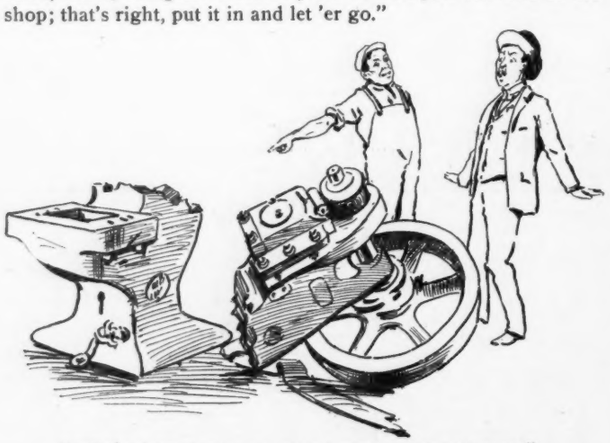
In the course of time business increased so that it was necessary for Billy to add a new press to his plant, and he bought a nice, new, big, strong, improved press.



"THERE, AIN'T SHE A DAISY?"

Being enthusiastic, he must show the new press to the first friend that happened in. "Come along out and see my new press," said Billy; "I tell you it's a beauty, and the most powerful machine you ever saw," and on getting his friend into the shop he walked him up to the new press. "There," said Billy; "ain't she a daisy?"

But Billy's friend, not being an expert on presses, did not enthuse sufficiently to satisfy Billy; so Billy said, "I will show you. Here, Mike, bring the thickest piece of iron you can find in the shop; that's right, put it in and let 'er go."



"DIDN'T I TELL YOU IT WAS A POWERFUL MACHINE."

But, alas! Billy was a little too enthusiastic. The piece of iron was too big for the press, and as the press was really powerful, something had to go.

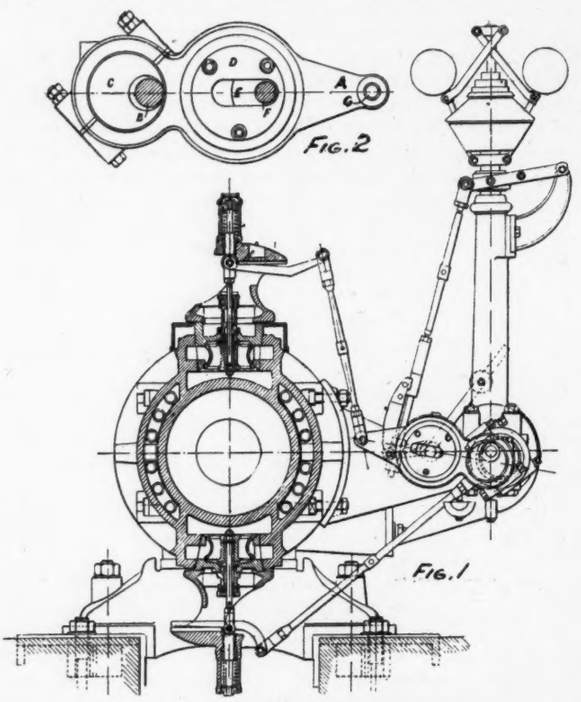
Maybe you think Billy said "—— —— —— the press to —— —— and ——"; but he didn't say anything of the sort. All he said was: "There, didn't I tell you it was a powerful machine?"

Billy's small shop has grown into a big shop, and I think that the two qualities of enthusiasm and never getting rattled had a great deal to do with the growth of the shop. SLOW PAY.

ITEMS OF MECHANICAL INTEREST.

A BELGIAN VALVE GEAR.

In a recent issue of "Engineering" (London), was a description of an engine made by the firm of M. J. Preudhomme-Prion, of Huy, Belgium, which is of a type quite familiar in European practice, but the valve gear of which possesses some interesting features. The valves are of the poppet type and are operated from a side shaft driven from the main shaft of the engine through bevel gears, and at all times remain under the direct control of the governor, although the admission may vary from *nil* to 60 per cent. Contrary to the usual system, the valve, instead of being raised to admit the steam, sinks into the steam; it is kept in that position by the lever which gives the point of cut-off required by the governor. The valve is balanced, and as soon as the lever ceases to hold it, it is returned to its seat by the pressure of steam.



The exhaust valves are worked from eccentrics on the side shaft. They are operated by steel rods which have at their ends a right-and-left handed screw, and are connected by a joint to a sliding lever, which itself commands the screwed valve rod. By this construction it is easy to provide for lead and compression at will.

Referring to the illustrations, Fig. 1 is a section through the cylinder, and Fig. 2 the lever of the valve gear, shown in enlarged detail and in a reversed position from that in which the same lever is shown in Fig. 1. This eccentric lever A, Fig. 2, is driven by the eccentric C keyed on the side shaft B, and turns also around the disc D. This disc is furnished with a rectangular opening in which slides the block E, keyed upon the shaft F. This shaft F can be turned by the governor to set the block E to different angles of inclination. The pin G, connected to the rod of the admission valve, follows paths of different forms, according to the position of the block E, and in this way the period of admission of steam is varied.

* * *

RIGG'S HYDRAULIC ENGINE.

In the hydraulic transmission of power it is generally the case that piston motors are the only ones capable of meeting the requirements of the service. For operating capstans, cranes, drawbridges, or for moving heavy masses, it is necessary to use a positively-driven motor depending upon the water pressure for its action instead of one of the more economical impulse wheels depending upon the kinetic energy of a water jet. In the piston motor the quantity of water used at each stroke is equal to the displacement of the piston, whether the load be heavy or light, and as the motor must be large enough to take care of the heaviest load to be carried, there is a large waste when running under

lighter loads. In fact, experiment seems to indicate that about double the power required to run a machine ordinarily must be used in starting or provided for in emergencies.

"The Engineer" (London) contains a description of a piston motor designed by Arthur Rigg, in which the piston displacement is made to vary with the load, and hence the quantity of

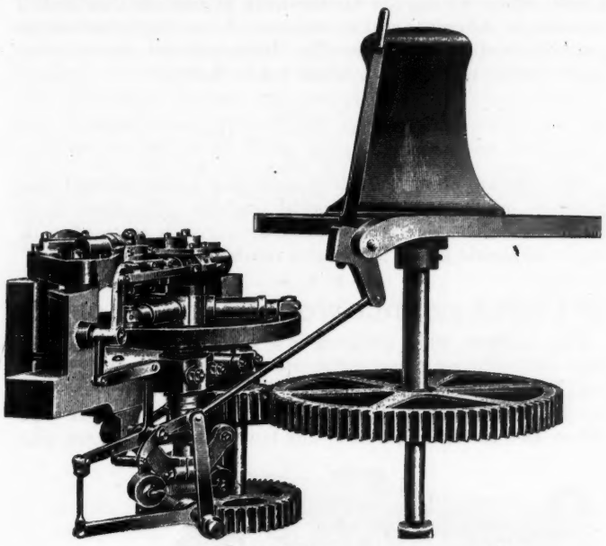


FIG. 1.

water used is always just sufficient to run the motor under the conditions at hand. This is accomplished by inverting the usual arrangement of stationary cylinders and revolving shaft and crank. In the Rigg's motor the crank does not turn and the cylinders revolve around it. Thus the crank radius can be altered as desired while the engine is running. The movement of the crank out or in from the center of what would ordinarily correspond to the shaft is accomplished by secondary cylinders under the control of the governor; and hence as the governor balls extend or contract, the stroke diminishes or increases, just as though the movement were caused by the governor directly.

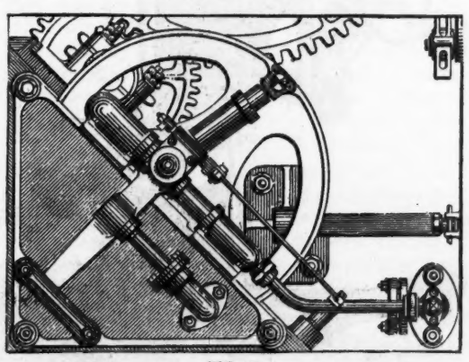


FIG. 2.

Figs 1 and 2 illustrate by perspective and plan one of Rigg's motors attached to a capstan, as illustrated in "The Engineer." The pistons and cylinders are three in number and are mounted on a heavy wheel which rotates about a vertical axis. The governor is seen at the lower end of the crank shaft, and in Fig. 2 the plungers for controlling the piston of the crank are clearly visible.

* * *

PORTABLE FRICTION BRAKE.

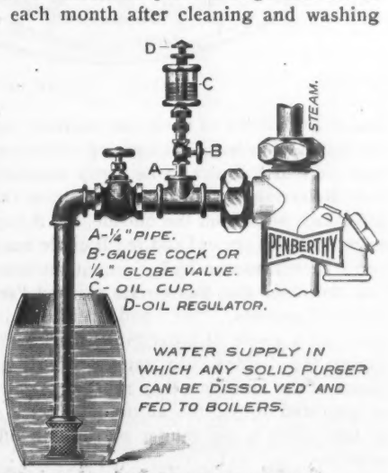
The English "Electrical Review" describes a neat form of portable absorbtion dynamometer or friction brake to be used in obtaining the brake horse-power of motors. An illustration is shown herewith. The brake is made in England by the Davies Motor Company, is of extremely simple construction, and gives perfectly definite weighing of the torque on the pulley under test against ordinary dead weights. It consists of a steel lever working on knife edges, which can be raised or lowered by the hand-wheel at the top of the brake. Holes are drilled in the lever at equal distances from the center, corresponding to the ordinary sizes of pulley in use. The center of the brake is placed over the center of the pulley, and from the two holes corresponding to the diameter of the pulley under test is suspended a piece of webbing, which passes round the pulley, as in the diagram. When the pulley is running, a weight, say, from ¼ to 30 pounds, is suspended on the end of the arm, as shown. The whole is then raised by turning the hand-wheel, tightening the belt on the pulley until sufficient friction is put on the belt to raise the arm to a horizontal position and keep it floating there; the speed of the pulley being taken at the same time. The usual constant, viz., $2 \pi L \div 33{,}000$,

L being the distance of the weight from the center, multiplied by the speed and the weight, gives horse-power direct. The size of the pulley, which should be perfectly smooth and flat, does not enter into the equation, so long as the distance between the holes in the arm is equal to its diameter; the band *must*, in all cases, be hung from two holes equidistant from the center. It is stated that every reading can be repeated with absolute certainty, and that each one does not take more than 10 seconds at the outside.

* * *

FEEDING BOILER PURGERS.

The Penberthy Injector Co., of Detroit, Mich., write that for many years it was their custom to place a large amount of purger in their boilers, each month after cleaning and washing out. For about six or eight years they have obtained better results by feeding the same amount at different periods during the month through their injector. For the benefit of steam users generally, they give their method of feeding purger to the boiler.



FEEDING BOILER PURGERS.

The accompanying cut shows the arrangement for feeding either from a barrel, or from a cup or tank. When the purger is in the form of a powder, it should be placed in a barrel and dissolved, and fed from barrel as shown in cut. In the case of kerosene oil or rather liquid purgers, an ordinary oil cup can be attached at a very small expense. A regulating cup is not necessary; as any

receptacle will answer so long as valve "B" is tight by which oil can be regulated. This attachment is applicable to the suction pipe of any injector, it being only necessary to have tight joints to prevent air getting into suction pipe.

Directions.—Close valve "B" and start injector, then open valve to desired feed. Close valve "B" before stopping injector.

The expense of oil attachment outside of cup which is not necessary will not exceed 50 cents. A short piece of large steam pipe reduced to ¼ in. will answer as well as the cup "C."

* * *

SEXTON'S OMNIMETRE.

Those who read the article upon the slide rule in the December number by A. H. Eldredge, will be interested in a new form of this instrument made under the copyright of Thaddeus Norris, and for sale by Theo. Alteneder & Sons, of Philadelphia, the well-known instrument makers.

The Omnimetre is essentially a circular slide rule. The principles upon which the operations of the Omnimetre are based depend upon the property possessed by logarithms that the sum of the logarithm of any numbers is equal to the logarithm of their product and that the difference of the logarithms of any two numbers is the logarithm of the quotient of those numbers.

The instrument has two circular discs and a radial runner, all capable of being moved around a common center. The outer disc has the A scale ruled upon its inner edge, and the inner disc has the B scale of the instrument ruled upon its outer edge. The diam-

SEXTON'S OMNIMETRE.

eter of the circles of these two scales is such that the scales are about 20 inches long, thus giving divisions coarse enough to enable the fourth figure to be easily estimated, and sometimes the fifth. Referring to the illustration, these two circles are the third and fourth ones from the outside, the A circle being marked "A" near the top of the cut and the B circle marked "B" near the bottom. It will be seen by looking at the lower half of the cut, also, that the inner disc has circles marked "secants," "N²," "sines," "N³," "Tangents," "N⁵" and "versed sines." The outer disc, also, has a circle of logarithms, marked "logs." These various circles are divided into parts proportional to the logarithmic values of the functions they represent; and besides being marked as indicated above, the adjoining circles are of different colors so that there is no danger of running off from one circle into another.

In solving examples, the runner serves the same purpose as on an ordinary slide rule, viz., to mark the intermediate position in a continued operation, and in addition it is used to facilitate the use of the inner or auxiliary circles by carrying their readings to or from the B circle.

The wide scope of the Omnimetre will at once be apparent. It is available for multiplication, division, and the main trigonometrical functions. The most used powers and roots can be determined at once and any power or root by using the outer circle of logarithms. As the instrument depends upon the logarithmic scale, it cannot be used for addition or subtraction except in special instances where the angular functions can be employed for finding the sum or difference of two squares. As an ilustration of the possibilities of the instrument Mr. Norris has sent us the following formula, among others, which can be solved:

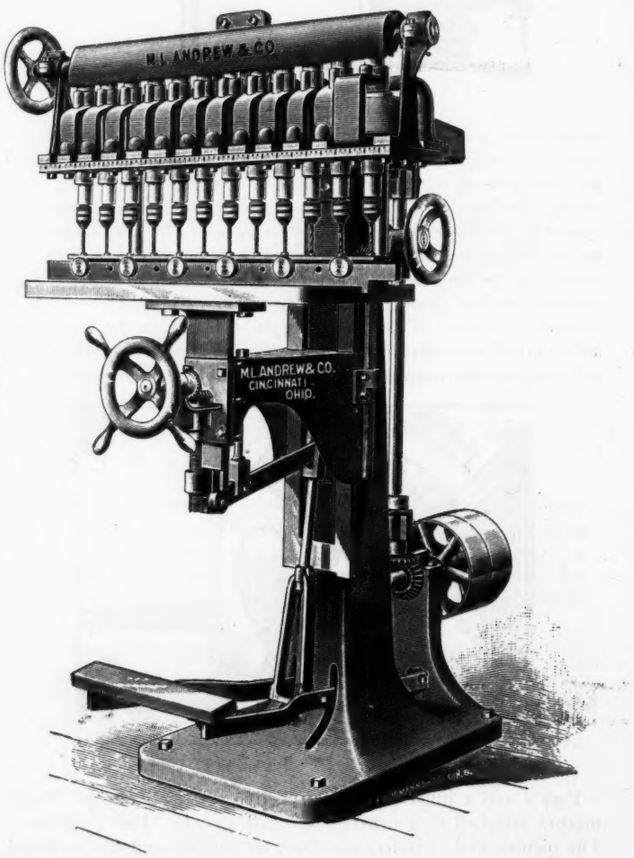
$$\frac{\sqrt[5]{1725^3} \times \sqrt[3]{237^2}}{\sqrt{\text{Secant } 83\ 15'}} = 1149$$

The discs are of non-absorbent cardboard and are printed from plates accurately ruled by a special machine. The discs of the instrument which we have examined are carefully centered, making it, we should judge, thoroughly reliable.

* * *

MULTIPLE SPINDLE WOOD BORING MACHINE.

This machine, while designed as a wood working machine, is built with sufficient power and accuracy for light iron or steel drilling. In the machine illustrated there are twelve spindles and there is a jig on the table for drilling twelve pieces of iron at one time. When used for drilling iron or any kind of hard metal, the pilot



wheel and screw is used for pressing the work up against the drills. When used for wood boring, the screw feed attachment is dispensed with and the foot treadle is used, which will produce very rapid work.

The following are some of the dimensions and prominent features of the 12 spindle machine. The spindles are all adjustable, and can be moved in a perfect straight line from 2½ inches to 30 inches apart. The table is 30 inches long by 16 inches wide. Distance from column to center of bit 16 inches, and takes in 12 inches between the table and point of bit, and will bore through 5 inches thick.

Machine occupies a floor space of 40 inches by 60 inches and 60 inches high. Tight and loose pulleys on countershaft 10 inches by 4 inches, and should run 325 revolutions per minute; weight of machine about 1,000 lbs. It is manufactured by M. L. Andrew & Co., 77-79 Elm street, Cincinnati, O.

HOW AND WHY.

A DEPARTMENT INTENDED TO CONTAIN CORRECT ANSWERS TO PRACTICAL QUESTIONS OF GENERAL INTEREST.

Give all details and name and address. The latter are for our own convenience and will not be published.

78 J. A. S. writes: Can you give a puzzled subscriber a method or formula for finding the angle to be cut on each side of a thread tool, say 60 degrees angle of thread, having 15 degrees clearance for that tool and 5 degrees clearance for right hand pitch of thread? A tool with a single clearance simply necessitates the angle being increased, but with the double clearance the angle on one side of the center must be greater than that on the other. A. We do not quite understand your language or sketches. The cutting end of the tool should be ground to an angle of 60 degrees for the angle of thread you refer to, and the angle is the same on each side of what we understand you to mean

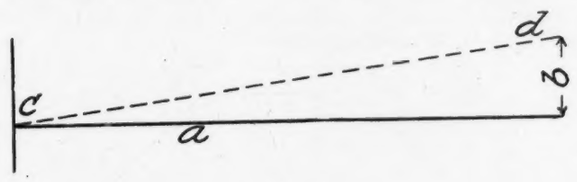


FIG. 1.

by the center without reference to what you speak of as clearance. To determine the rake or side clearance of the tool draw the line *a*, Fig. 1, of a length equal to the circumference of the screw at the bottom of the thread. Lay off the distance *b*, equal to the pitch of the threads and draw the line *c d*. This is the angle of the spiral at the bottom of the thread. Set the bevel to as much greater angle than that indicated by line *c d*, as you desire the cutting angle to be and one edge of the blade will be right for the advancing side of the tool and the other for the opposite side. If this does not answer your question, we should be pleased to have you write again.

79. W. S. T. writes: In making paper on a Fourdrinier machine there are two or more suction boxes placed directly under the wire cloth. The tops of these boxes are perforated and are on a level with the wire cloth. They are intended to remove some of the surplus water from the pulp. The air is exhausted from these boxes by a pump, a syphon, or by a pipe connected to the draught tube of a water wheel. The rush of water past the end of the pipe in the draught tube maintains a sufficient vacuum in the boxes and the pipe, which pipe carries away the surplus water. The size of wheel (upright) is 66 inches, head 30 feet. Water wheel manufacturers say the draught tube should be perfectly air tight, still I have found a number of wheels piped in the way indicated. What I want to know is if it impairs the efficiency of a wheel to pipe the tube in the way indicated, and will the step wear faster? A. We should not expect this pipe would have very much effect one way or the other, on the running of the wheel or wear of the step, which opinion would be strengthened by the fact that wheels piped in this way are in operation. Still, since it would involve but little trouble, we should write to the manufacturer of the wheel, and make such observations as we could of wheels so piped. We have ourselves written to two water wheel manufacturers, one of which replied: "If, as we apprehend, the proposed pipe is to draw water from the suction boxes and to utilize the suction of the draft-tube to aid in that, then we see no harm liable to accrue to the wheel step or to the action of the draft tube, so long as no air is admitted to the tube. But if air is allowed to enter the draft tube by it, the action of the draft will, of course, be impaired. For this use, however, no advantage would be obtainable over running the 2-inch pipe directly to the tail water of the wheel pit, which so long as the pipe is supplied with water will afford just as much suction as to enter the draft tube of water wheel." The other manufacturer writes: "In regard to the 2-inch pipe being conveyed from the suction box to the draft tube of turbine, would say that we should not advise such an arrangement. It is a source of possible trouble."

80. W. A. W. asks: 1. What is the proper angle for the seat of valve in the bottom of a hydraulic jack? A. An angle of 45 degrees is probably as good for valve seats as any. We do not know anything about the construction of your jack, but should presume this angle would be satisfactory. 2. What kind of leather is best for the cup-packing of a jack, and where can it be obtained? A. The best oak tanned leather; you can get it from any reputable dealer in leather. If the jack is of moderately recent manufacture, you can order the packing from the manufacturer. 3. Where can a book on jacks be obtained? A. We do not believe there is any book published treating principally of jacks. Manufacturers' circulars will probably give you as much information as you can get anywhere.

81 J. E. J. writes: 1. I have a duplex double-acting air compressor, 3¾ x 4½ inches, making 150 revolutions per minute. Will it supply air enough at 50 pounds pressure to run two small engines 2¼ x 2 in., at 300 revolutions per minute? A. The free air capacity—the piston displacement of the compressor—is, in round numbers, 17 cubic feet per minute. From this deduct 2½ cubic feet for loss from imperfect operation and the compressor will furnish 14.5 cubic feet of free air—air at a pressure of one atmosphere—per minute. The displacement of the pistons of the engines is 5.52 cubic feet per minute. The air is to be used at 50 pounds, gauge presure, say 4½ atmospheres. This is equivalent to $5.52 \times 4.5 = 25$ cubic feet, say, nearly, of free air. Add 20 per cent. for clearance and, $25 + (25 \times .20) = 30$ cubic feet of free air per minute, will be required by the engines. The capacity of the compressor is scarcely one-half what it should be. 2. What should the capacity of the receiver be? A. It cannot be too large. Common practice is to make it of a capacity to hold as much air as the pump will deliver in one minute. To supply the engines let the receiver have a capacity of not less than 10 cubic feet.

82. R. T. G. asks: 1. Has anyone succeeded in tempering copper, and if so, is there any patent on the process of tempering? A. By tempering we presume you to mean hardening, as for a cutting tool. There are stories to the effect that the ancients understood the art of tempering copper; that it is one of the lost arts, so called. As a matter of fact, we do not believe that copper was ever tempered to serve the purpose of a satisfactory cutting tool. 2. In what way can Mushet steel be annealed? A. B. M. Jones & Co., Boston, Mass., the agents for Mushet's steel, issue a circular containing directions for treating this brand of steel, which states: "After the steel is forged, heat it up thoroughly to a light yellow (short of burning), and bury it in hot ashes from the smithy fire, or in lime, and cover over with fine ashes or sawdust so as to exclude the air thoroughly until perfectly cold. The steel will then be annealed for turning, filing, etc.; but if it is found to be hard below the surface when cut into for working, it may be necessary to anneal again before fininshing." We also referred this question to our corrspondent, S. W. Goodyear, who writes that as far as his experience goes, the annealing of self-hardening steels is acomplished by the same methods employed in annealing ordinary carbon steels, except that the heat should be longer continued and greater care taken to hermetically seal, or nearly so, the case in which the steel is packed with charcoal He kindly sends the following directions: "Pack in a case with plenty of fine charcoal. Lute the cover with clay to make practically air-tight, heat in furnace, letting the heat come up slowly and let the work remain in case until cold. If practicable let furnace and all cool down together. A 24-hour operation, probably, would be my advice under my present knowledge of the matter."

83. B. F. and H. K. both ask questions in relation to the pitch of gears and size of blanks, which we have, for convenience, combined as follows: 1. I am an apprentice, and am a little confused by some of the terms I hear used in regard to the pitch of gears. I know that the pitch of a gear is the distance apart of the centers of two teeth, measured on the pitch circle. What I would like to know is, what diameter pitch is, and how I can reduce the pitch as used by the patternmaker to diameter pitch? A. The diameter pitch bears the same relation to the diameter of the pitch circle that the circular pitch, which the patternmaker uses, bears

to its circumference. If we multiply the circular pitch by .3183, the product will be the diameter pitch. Thus a gear of ¾ (.75) inch circular pitch is .75 × .3183 = .2387 inch diameter pitch 2. I have a gear of 84 teeth, 16.5 inches outside diameter, and about 16 inches pitch diameter. If I divide the circumference by the number of teeth, will not that give me the circular pitch? A. If you divide the pitch circumference by the number of teeth, the quotient will be the circular pitch. 3. If I divide the circular pitch by 3.1416, (or multiply it by .3183), will not that give me the diametral pitch? A. No. You appear to confound diameter pitch with diametral pitch. Diametral pitch is the number of teeth in a gear for each inch pitch diameter. Thus the diametral pitch of a gear 16 inches pitch diameter, having 84 teeth, is 84 ÷ 16 = 5.25, which signifies that there are 5.25 teeth for each of the 16 inches diameter. Assuming your pitch diameter to be stated right, the diametral pitch is 5.25, as has been said. To find the outside diameter of a gear of 84 teeth, 5.25 diametral pitch, add 2 to the number of teeth and divide by the diametral pitch. In your case the outside diameter would be, if the pitch diameter is 5.25,

$$\frac{84+2}{5.25} = 16.38 \text{ inches.}$$

On the other hand, if the outside diameter is correctly given, and the gear was properly sized, the diametral pitch is found by adding 2 to the number of teeth, and divide by outside diameter of gear.

$$\frac{84+2}{16.5} = 5.2121$$

the diametral pitch. 4 I wish to make a gear of 19 teeth to run with this gear. If I divide the number of teeth plus 2 by the diametral pitch will not that give me the outside diameter? A. As has been said, yes. But you must reconcile the diametral pitch and size of blank. Again assuming your figures for pitch diameter to the right, the outside diameter of small gear will be

$$\frac{19+2}{5.25} = 4 \text{ inches.}$$

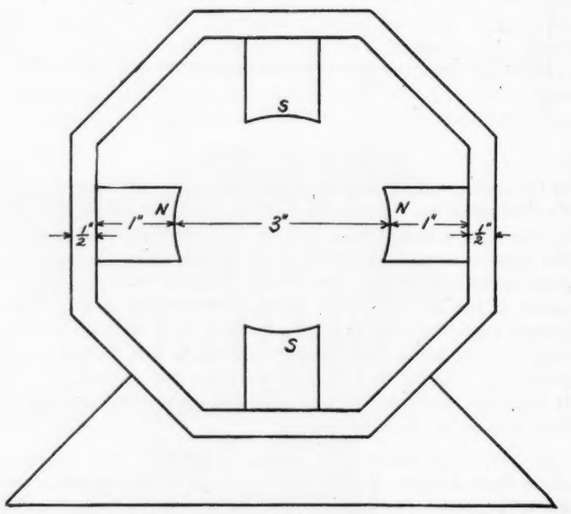
If, on the contrary, the outside diameter of large gear is right, then the outside diameter of small gear will be

$$\frac{19+2}{5.2121} = 4.03$$

If your gear was made where the custom is to work by diametral pitch, we believe the diametral pitch was 5.25, and that a mistake was made in the sizing of the blank. If not, 5.2121 may be nearest right. To recapitulate, assuming the blank to have been correctly sized, to find the diametral pitch, add 2 to the number of teeth and divide by the outside diameter. As diametral pitch is commonly used a gear is said to 3, 4, etc., pitch, the meaning being that there are 3, 4, etc. teeth to the inch diameter. The circumference of a circle is 3.1416 times its diameter, hence dividing 3.1416 by the diametral pitch gives the circular pitch. Thus a gear of 5.25 diametral pitch is 3.1416 ÷ 5.25 = .5984 inch circular pitch. Conversely, if the circular pitch is .5984 in. then 3.1416 ÷ .5984 = 5.25, the diametral pitch.

84. D. A. R. asks: I have trouble with the water line on the boiler. I take the steam from the dome and the water through the back head about five inches above the bottom of the shell. After leaving the back head the pipe turns and passes along inside the setting to the front of the boiler and out to the water line casting. The water rises to the top of the glass, then in a few minutes it will fall to the bottom, and so on, never remaining quiet except when the ash-pit doors and damper are closed; then if I open the bottom drip of water line for about two minutes it will come to rest. This is all the way I can tell where the water in the boiler is, by the water line. I have had to haul the fire twice from low water. Can you suggest a reason for the water line behaving as it does? A. The reason is plain. The water in the pipe is exposed to the hot gases direct from the furnace for several feet of its length, and is converted into steam, which could not do otherwise than cause the fluctuations in the glass when you are making steam. When the doors and damper are closed the space through which the pipe passes cools down, and running water out at the drip cools the pipe and the water in it down to its normal temperature and the glass correctly indicates the height of water in the boiler. The arrangement is dangerous. Take the water through the front head, and as direct to the water line casting as possible. Let the pipe be not less than ¾ inch diameter. Sometimes taking steam from the top of shell instead of from the dome will steady the water column, but probably all your trouble comes from the water pipe. Place one gauge cock in the front head at such a height that when you cannot get water from it—when you get steam—the conditions are getting dangerous.

85 G. G. asks: What will be the length of the magnetic circuit of a motor like the accompanying sketch, and how many layers of wire will be required on the outside surface of the armature of the grooved type if each pole of the field has an area of one square inch, and is wound to produce 60,000 lines per square inch? You can assume the current to be taken from five batteries of 2 volts and 12 amperes each. By connecting two batteries together of 2 volts and 12 amperes each make a current of 4 volts and 24 amperes. A. The length of the magnetic circuit in the sketch is very nearly seven and a half inches. If the motor is to be run by five batteries of 2 volts each, equal 10 volts, the number of wires on the armature surface for a velocity of 1,500 per minute will be about 680, and for double this velocity, 340. The fact that



each battery can give a current of 12 amperes does not show that it will do that much when supplying the motor; the strength of the current will depend upon the resistance. Two batteries in series will not give 24 amperes unless the resistance is one-sixth of an ohm, and it cannot be so low unless the internal resistance of the batteries is about two hundredths of an ohm for each one. As the field cross section is so small the number of turns on the armature must be large, and there being so many turns to be accommodated in so small a space the wire will have to be small and therefore of considerable resistance. Therefore it is probable that the actual strength of the current will be nearer 2 amperes than 24.

* * *

LUBRICANTS, OILS AND GREASES, by I. I. Redwoood. Published by Spon & Chamberlain, 12 Cortlandt street, New York. 54 pages, 8 vo. Price $1.

In dealing with the subject embraced by this little work, the author has attempted to give engineers an insight into the properties of the various lubricants that are likely to be offered to them, and thus enable them to guard against the choice of one that would be likely to prove unsatisfactory for the purpose intended.

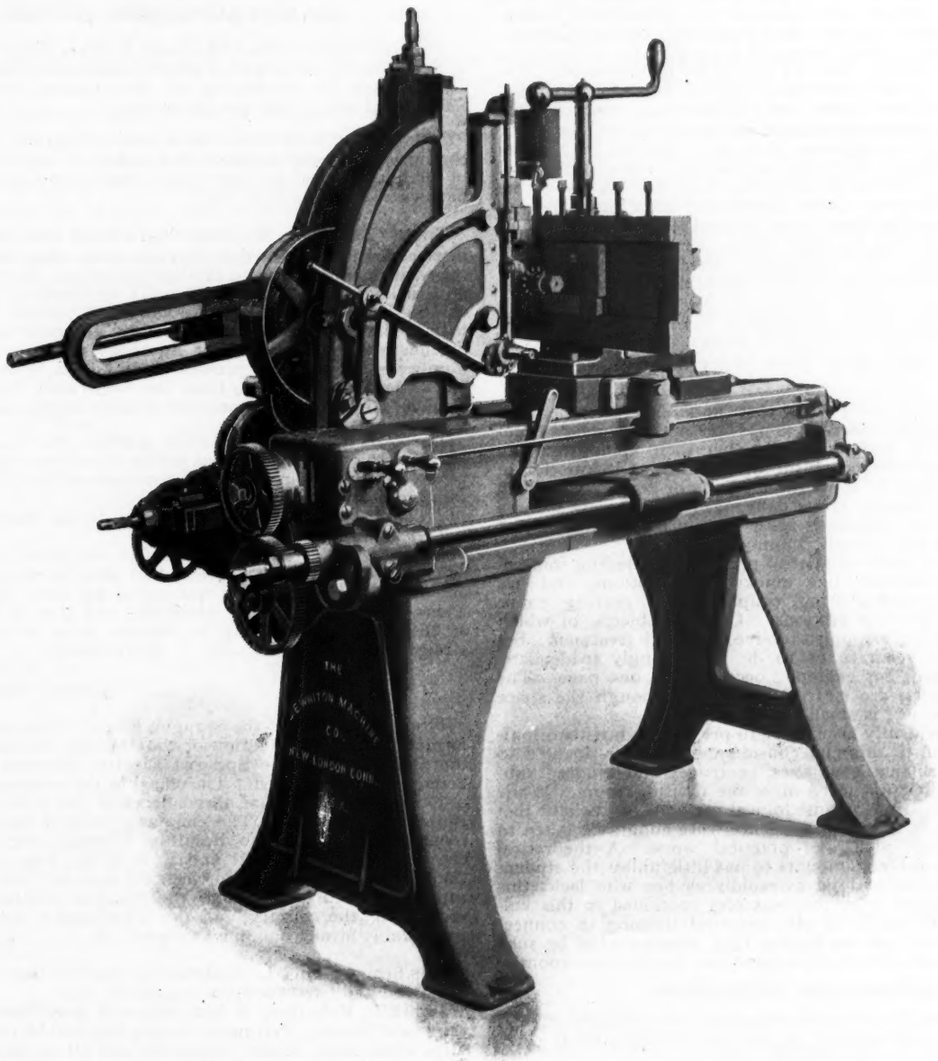
Also, the author has briefly explained the theory and general requirements that govern the manufacture of lubricants—greases in particular. The treatment is very short and gives the main facts only. The book is of English origin.

THE APRIL CENTURY is to contain a number of articles on Pennsylvania coal mining, one of them by Jay Hambridge, the artist, who contributes "An Artist's Impressions of the Colliery Region." The illustrations include views in Lattimer, where the recent strikes occurred, and Mr. Hambridge has made a great number of interesting sketches of the many types of people that he found in the collieries. The Italians are called "Hikes," and the other foreigners—Slovaks, Polacks, etc.—are grouped under the name of "Hunks."

Manufacturers, either domestic or foreign, who intend building new plants or adding to their present ones, who are looking for special tools, or who want to buy or exchange machinery, are offered without charge the use of the information on these subjects accumulated in this office

A greater variety and greater quantity

of work can be turned out on the WHITON GEAR CUTTER than on any similar machine in the market. It is well to consider this before you put a Gear Cutter into your shop. Look over the different makes carefully and compare ours with the others.



The Whiton Gear Cutter is adapted to cutting spur gears, bevel gears and racks, and to hobbing worm wheels without first nicking the blanks.

There is no overrunning of the cutter, and the spacing and quick-return mechanisms operate with the highest speed. The machine is absolutely rigid, and the feed and depth of cut is limited only by the durability of the cutter. These features ensure an output that was formerly thought impossible with a machine of this class.

Full particulars furnished by the manufacturers,

THE D. E. WHITON MACHINE COMPANY,

No. 54 Howard Street, New London, Conn., U. S. A.

FRESH FROM THE PRESS.

PRACTICAL SHOP TALKS, by Fred H. Colvin (Ichabod Podunk). Published by Locomotive Engineering, 256 Broadway, New York. 144 pages, pocket size, bound in cloth. Price 50 cents.

When it is announced that the "Notes from Notown" by Ichabod Podunk, which have appeared in the columns of MACHINERY during the past three years have been gathered between the covers of a book that sells for 50 cents, we imagine it is all it will be necessary to say to make every reader want a copy. As all probably know, Mr. Colvin, the former editor, is author of this series, and it will be no disparagement to the work of the other contributors to say that it has undoubtedly been the most popular series that has appeared in these columns.

Examples of actual shop practice and management, or, rather, mismanagement, are dealt with and include incidents that have passed under the author's own observation. The different chapters are always interesting and often amusing, a style of presentation which serves to drive home the lessons to be learned in a more convincing manner than by argument or discussion. The book tells about actual occurrences, real or otherwise, that happened in "Notown" or vicinity, but it is safe to say that what has happened in Notown is happening every day in every town. The principles of good management that were violated in Notown are violated everywhere, and there will be few readers of the book who do not find plenty of places where it applies. A few of the subjects dealt with are: Office Interfering with Shop; Boring Cylinders; Stealing Designs; Shop Rules; Piece Work; Speed of Machine Tools; Setting Up Poor Work; Freezing Jackson Out; Combination Tools; The Squeezum Can Co.; Looking After Details; Insurance Against Accident; Heating the Shop.

MACHINE DESIGN. Part 1, Kinematics of Machinery. By Forrest R. Jones, Professor of Machine Design in the University of Wisconsin. 159 pages, 8vo. John Wiley & Sons, New York. Price, $1.50.

The author states in the preface that "an attempt is made, first, to give, as clearly and concisely as possible, the principles of mechanical motion in such a manner that their application can readily be made to any mechanism for determining the motion of any of its parts; then to show the methods of dealing with such problems as the designer meets daily. . . . Subjects such as toothed gearing and couplings are taken up only to the extent of the forms that are in most common use."

The first volume treats of general principles, including some of the leading mechanisms, like quick-return motions, and has chapters upon toothed gearing, couplings, belt gearing, cams, parallel and straight-line motions. Certain subjects, of which cone pulleys are an example, receive very full treatment; but some other parts seem to us to be surprisingly inadequate. "Wheels in Trains," for example, occupy only one page. The essentials of gearing are clearly explained, although the space devoted to the subject is small.

An effort has evidently been made to present a consistent, logical treatment, and to this end considerable space is devoted to velocity ratios, instantaneous axes, centrodes and kindred subjects, which are seldom heard of in the drafting room. While we do not wish to argue against logical methods, we believe that when mechanism is taught as a science, care should be taken to supplement it with plenty of practical work. A theoretical knowledge of the subject amounts to but little unless the student can plot out motions at least as rapidly as one who lacks this knowledge. Judging from the examples contained in this volume, Prof. Jones intends to give practical training in connection with the other, and we believe that, supplemented by such instruction, the book will prove a good one for the class-room.

ADVERTISING LITERATURE.

THE STANDARD SIZES FOR CATALOGS ARE 9 X 12, 6X9 AND 3½X6 INCHES. THE 6X9 IS RECOMMENDED, AS THIS SIZE IS MOST LIKELY TO BE PRESERVED.

GLEASON TOOL CO., Rochester, N. Y., catalog of tools and gears, 103 pages, 6¼x8¼, illustrated.

This book, which is called "Machine Tools and Gears," is handsomely bound in cloth, and in addition to advertising matter, contains 30 pages of practical information about gear designing. The treatment of the subject is very clear, fully illustrated with original drawings, and includes pages devoted to Forms of Teeth, Sizing Gear Blanks, Laying out Bevel Gears, Sizing Bevel Gear Blanks, with directions for turning bevel gear blanks and cutting the teeth. The first part of the catalog contains illustrations and descriptions of the Gleason lathes, planers and bevel gear cutters. In addition to these a large number of pages are used for listing the spur and bevel gears which are either kept in stock or are made to order by this company. The list includes both cut and machine moulded gears and net prices are given.

THE JONES & LAMSON MACHINE CO., Springfield, Vt., have issued a catalog entitled "Screw Threads," devoted to the Hartness automatic die, made by this company. The appearance of the catalog is fully up to the high standard set by their regular flat turret-lathe catalog. The principle of the die is explained, the method of manufacture described and directions given for using it. Very accurate results are claimed for the die and reasons are given for these claims. There is also a table of speeds for screw cutting.

THE INGERSOLL-SERGEANT DRILL CO., Havemeyer Building, 26 Cortlandt street, New York. Catalog No. 41 of Mining, Tunneling and Quarrying Machinery. Standard size, 6x9 inches.

This is another catalog which is a model of the printer's art. It contains descriptions with very full illustrations of rock drills, quarry bars, stone channeling machines and air compressors. The prices and sizes are also listed.

EXPERIENCE, NOT EXPERIMENT, is the title of a pamphlet issued by the Goheen Manufacturing Co., Canton, O. It contains letters from firms who have used either the "Carbonizing Coating" made by this company for the preservation of iron and steel, or else their regular line of structural paints.

* * *

MANUFACTURERS' NOTES.

THE latest move of the wide-awake Colliery Engineer Company of Scranton, Pa., is to put an elegant advertising car of their own on the road for advertising the International Correspondence Schools, of which they are proprietors.

JOHN NEEDHAM & SONS, Manchester, England, write us that they are about to open offices in London for American products, in the lines of steel and iron in all shapes and grades, pig iron, hardware, machine tools, etc.

THE DAVIS & EGAN MACHINE TOOL CO., of Cincinnati, O., have just received several orders through their office at Berlin, Germany, including one from the "Gewerkschaft Deutscher Kaiser" at Brückhausen (Rheinisch Prussia) for fourteen machines, including lathes, planers, shapers, and drill presses. This is said to be the largest steel works in Germany. Another is from the Bayreuther Maschinen Fabrik at Bayreuth, near Dusseldorf, for a number of upright drill presses, radial drills, 36-inch lathes and bolt cutters; and also one from the Locomotiv Fabrik Maffei at Munich, Germany, for a number of large engine lathes.

THEO. AUDEL & CO., 63 Fifth Avenue, N. Y., publishers of Hawkins' works, have sent us a copy of a letter regarding these books, received from one of the survivors of the "Maine," which we give below:

"HAVANA, Cuba, March 7th, 1898.

"*Theo. Audel & Co:*

"DEAR SIRS: Inclosed you will find one dollar for payment of one set books. Am in a pretty bad position at present, being one of the Maine crew, but was one of the lucky ones to escape. There is one thing I am sorry for, and that is I lost my set of books, but I am going to replace them as soon as I get straightened out. I remain, Respectfully,

"C. H. BULLOCK,
"Gunner's Mate, 1st class."

THE organization of the Sprague Electric Company, which was formed by the consolidation of the Interior Conduit and Insulation Company and the Sprague Electric Elevator Company, is being rapidly perfected. The offices of the company now occupy practically the whole of three floors in the Commercial Cable Building, New York. The company recently secured a suite of rooms in the Marquette Building, Chicago, which will be in charge of Millard B Kitt and E B Kittle, long identified with the company. Well known electrical men and houses are being rapidly secured to represent the Sprague Company in various sections of the country, and the organization bids fair to be a remarkably strong one in every way.

THE firm of James L. Robertson & Sons, of this city, has been dissolved and two new firms organized, viz.:

James L. Robertson & Son, who will give their attention to the sale of Eureka, Fairmount square flax, and all other packings; Hine eliminators, steam separators and oil extractors, engineer and mill supplies. The Robertson Manufacturing Co., who will make a specialty of manufacturing indicators and their attachments, together with feed-water heaters, grate bars, exhaust heads, damper regulators and other mechanical steam specialties.

The main object of this change is to afford Mr. James L. Robertson a well earned rest from the exacting details of a constantly increasing business; and his many friends in the trade will join us in wishing the younger men who have now come to the front as full a measure of success and popularity as their senior has attained.

WANTED.—Experienced foreman to take charge of department in machine and forge shops, running all night. Applicants must have had experience in modern shop methods and duplicate work. Address, American Ordnance Co., P. O. Box 595, Lynn, Mass.

WANTED.—Complete copies of MACHINERY, Vol. I. Address, stating price, "A. B.," care of this office.

SMALL STEAM ENGINES AND BOILERS.—Castings $2.00 up. Also castings for water motors, gas engines and locomotives. Circulars free. GRANT R. SIPP, Paterson, N. J.